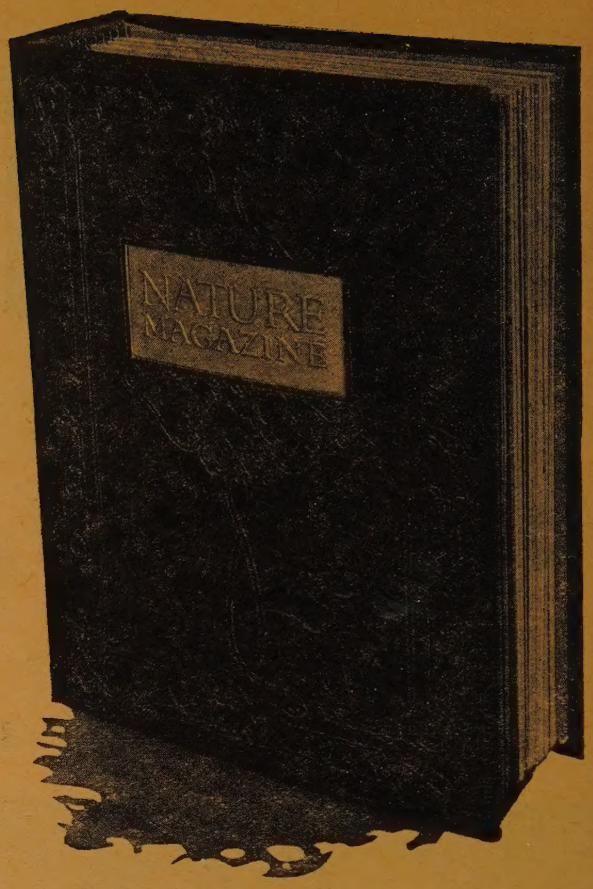
NATURE MAGAZINE

ne-July, 1944 35 Cents Vol. 37, No. 6

Keep a Year's Issues of NATURE MAGAZINE in this Handsome Binder



"Where's the latest copy of Nature Magazine?" How often you have heard that question! And how often an answer like this: "Look on the chair . . . over in the corner!" Like as not, the much desired copy will turn up under the cushion in the window seat. And great will be the lament at torn pages and creased pictures.

Unlike most magazines, Nature Magazine is the sort you want to keep. Naturally issues accumulate. There's an easy solution to the problem of mislaid copies, unsightly disorganized piles of magazines. Get one of these binders specially prepared for Nature Magazine.

Just slip in the copies of Nature Magazine as they arrive. Snap them in with the little unbreakable hooked wire. This binding device while light is strong and sturdy, guaranteed to withstand all ordinary usage. The copies may be removed as easily as they are inserted. At the end of the year, remove the year's copies and have them bound. Your binder is then ready to serve another year, accommodating each issue as it arrives.

Always Protected and Right at Hand

This binder looks and handles like a book. It is a bound book in every respect except that you snap the magazines in the cover one at a time. It opens flat as a bound book, which makes it easy to handle and to read. It keeps the magazines handy for a year—or as long as you wish to retain them in the binder. Meanwhile the contents are protected from handling, tearing and from being mislaid or carried away. The binder is finely grained, dark green, gold embossed . . . a handsome addition to desk or library.

← Opens Flat like a book

This De Luxe Binder only $2.25

The cost of making this binder has increased; the supply is limited; and it may not be possible to get a new supply for duration of the war.

Send for your binder today before this copy of your magazine gets mislaid. Satisfaction guaranteed or your money refunded. Use the coupon here or, if you prefer, write us your order so as to avoid cutting the magazine.

AMERICAN NATURE ASSOCIATION
1214 Sixteenth St., N. W.
Washington 6, D. C.

Send me ..... of your De Luxe Binders for NATURE MAGAZINE, for which I enclose (check, P. O. Money Order) for $.....

Name .....

Street and No. .....

City and State .....

Civic Annual

American Planning and Civic Annual. American Planning and Civic Association. Washington, D. C. 1944. 195 pages. $3.00.

Declaring that "without public planning there is no conservation," the American Civic and Planning Association, in bringing out the 1943 edition of this annual, calls for a new birth of conservation in the post-war period to prevent the exploitation of our irreplaceable natural resources. As usual this publication is a round-up of information on recent progress in the fields of planning, parks, housing, neighborhood improvement and conservation of natural resources. It is edited by Harlean James, secretary of the Association.

Our Land

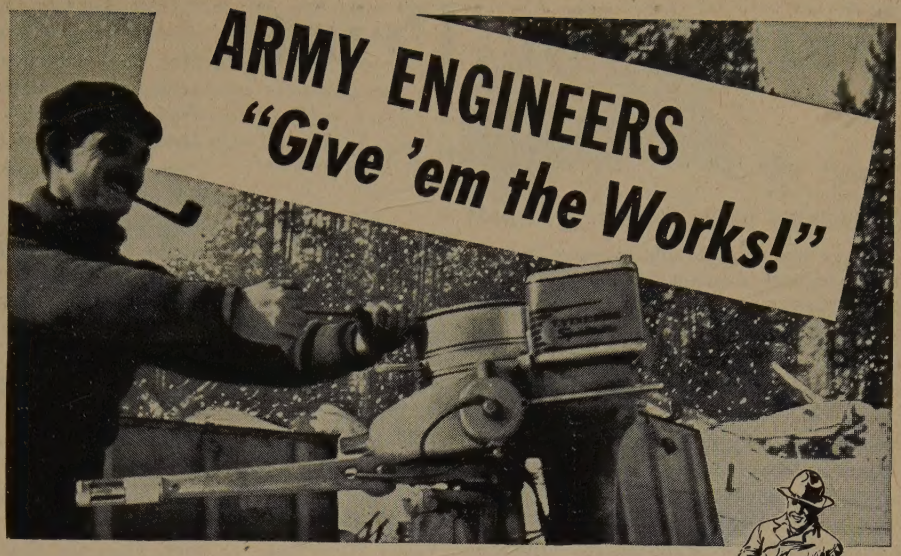
The Land We Live On. By Carroll Lane and Mildred Adams Fenton. New York. Doubleday, Doran. 1944. 98 pages. Illustrated. $2.50.

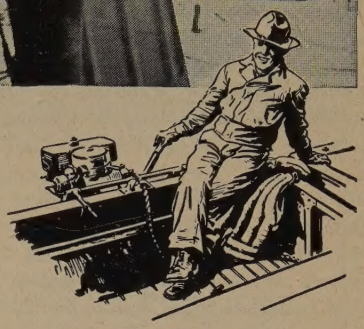
This is a book for every boy and girl who wants to know about the land, how it came to be, how it changes, what it means to the lives of a nation and how it may better be used. The authors have chosen a graphic pictorial approach with carefully-selected, story-telling pictures accompanied by brief and effective text. We have long taken the land for granted, abused it abominably in great measure. Only recently is it dawning upon the people that land is fundamental; that it must be treated with care and respect. This is going to be the basic theme of all conservation of the future, and this little book fits perfectly into the emphasis on this theme.

Conservation

Conservation in the United States. By A. F. Gustafson, C. H. Guise, W. J. Hamilton, Jr., and H. Ries, Ithaca, N. Y. Comstock Publishing Company. 1944. 477 pages. Illustrated. $4.00.

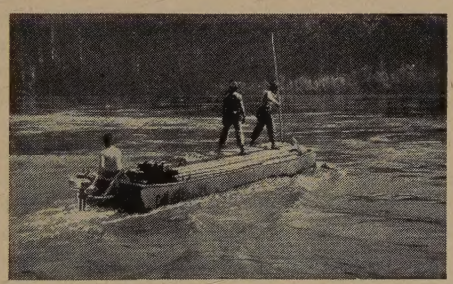
This is a second and revised edition of an important conservation book first published in 1939. Since that time we have entered into a world war that has brought with it new conservation problems. New information has become available and new practices have been adopted. Also, the war has focused the spotlight sharply upon our natural resources and our handling of them. Thus, to keep abreast of the changes of five years, this text has been revised and brought up to date. The authors express the hope that this edition "will help to impress the public, more than ever before, with the importance of the country's natural resouces, with the imperative need for their wise use, and with a knowledge of the ways in which they can be conserved."





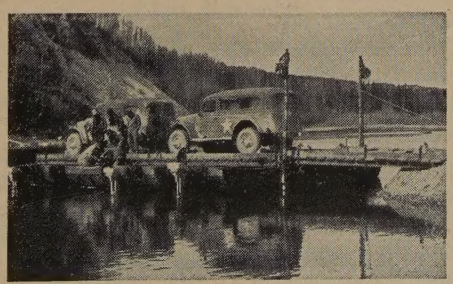
"What would the Ar-my do with-out the En-gi-neers?" pops the $64 question in "Song of the Engineers". A hard one to answer! Wherever the Army advances, in tropic jungle or arctic outpost, the Engineers are out in front preparing the way . . . building air bases for our flying forces . . . throwing bridges across broad rivers . . . constructing highways over formidable mountain ranges . . . resourcefully transforming all kinds of "impossible" assignments into routine tasks.

Speed is a vital factor with the Engineers, and outboard motors have proved highly useful in ferrying, bridging and many other operations. The Evinrude above, fresh from its packing case, will soon know what it is to "get the works" from the Army's hard-working Engineers.

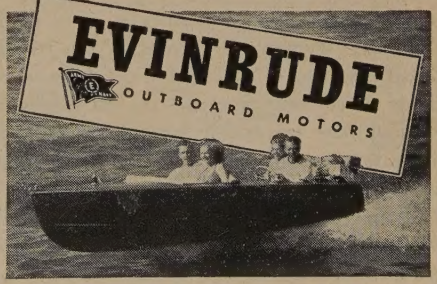


1 Mounted on a standard Engineers' ponton, (the Army term is *ponton,* not "pontoon"), this Evinrude makes fast work of transporting bridge material. It takes *stamina* as well as power to deliver the goods in this kind of service!

2 Ferries built quickly — here's how they do it! Several pontons are decked together with standard bridge material and, with motors mounted, the ferry is ready! Here 3 Evinrudes do a "triple screw" job pushing a truck up stream.



3 Ready to go with another load. Such service is not as spectacular as that performed by the great Evinrudes that drive the Engineers' speedy Storm Boats, but it's important — and it may have to be done under battle conditions!



4 After Victory there will be thrilling new Evinrudes for all to enjoy! Today it is *our* job to deliver to our fighting forces the finest motors that all our skill and long experience can build! EVINRUDE MOTORS, *Milwaukee, Wisconsin.*

EVERY DOLLAR YOU INVEST HELPS SPEED VICTORY...BUY MORE WAR BONDS

Nature in Print

By HOWARD ZAHNISER

There was considerable expectation aroused recently by The Bobbs-Merrill Company's announcement of "The American Lakes Series," and the first of the five volumes projected so far is indeed a justification of high hopes. It is a valuable and at the same time an intensely interesting discussion of Lake Huron, the first of the five Great Lakes to be discovered by Europeans. Under the general editorship of Milo M. Quaife, it has been written by a Canadian scholar and journalist whose choice of materials and skill in writing have set a high standard for the series. Milo M. Quaife, who himself intends to write the volume on Lake Michigan, is secretary of the Burton Historical Collection and a former editor of The Mississippi Valley Historical Review. "It is safe," say his publishers, "to say that no other historian now living is better known as an authority on the Great Lakes." Fred Landon, the author of *Lake Huron*, is the librarian and a history professor of the University of Western Ontario, a past president of the Canadian Historical Association, and a man who in his youth "spent four years sailing in vessels of the Northern Navigation Company and in his lifetime has made more than a hundred Lake voyages." With the confidence in validity that such editorship and authorship warrant, and with the demonstration made in *Lake Huron*, it seems safe to accept with only slight reservations the publisher's promise that the series "will be welcomed not only by scholars and historians but by all readers who are in any way interested in the Great Lakes or who respond to the romance that has always hovered over their waters."

Professor Landon has discussed Lake Huron from four points of view—historical, geographical, anecdotal, and nautical, as one might describe them. So well has he written that it would be difficult to say which point of view is the most interesting. Historically he is dealing with Champlain, other pioneers, pathfinders, missionaries and martyrs, voyageurs and fur traders, and warriors. Geographically he entitles the second part of his book "Islands, Shores and Rivers," and the chapter headings he has chosen suggest their interest—Along the Michigan Strand, Up the Canadian Shore, Around the Shores of Georgian Bay, Along the St. Clair River, Among Lake Huron's Myriad Islands, and The Magic Island in the Straits.

Throughout the book there is a wealth of human interest, but in Part III this interest is dominant. The episodes of an armed uprising, the catastrophe of a collision between two passenger steamers, the sketch of the travels and visits of an English woman of letters, and the bizarre yet notable achievements of an army surgeon are all fascinating as stories, and together they serve well the purpose of suggesting the human living that for men becomes an essential part of the concept of any natural feature of the landscape. The army surgeon, Dr. William Beaumont, saved the life of a French-Canadian at Mackinac but, try as he would, he could not get the wound to heal. Instead he became famous, for the wound happened to become a sort of valve whereby the doctor could observe what was going on in the patient's stomach. He published his epoch-making "Experiments and Observations on the Gastric Juice and the Physiology of Digestion," and he made the now-orthodox statement: "The system requires much less than is generally supplied to it. Dyspepsia is oftener the effect of over-eating and over-drinking than of any other cause."

It is, however, in the fourth and final part of his volume, when Professor Landon is writing about "The Ships and The Men Who Sail Them," that he seems to be dealing with his own great enthusiasm, and even a landlubber can be fascinated by Professor Landon's accounts—and the excellent photographs of beautiful lake-going vessels he has collected. "Who," he asks, "can measure the value of these Great Lakes in the economic life of the two nations that use them in common? . . . And by what yardstick can we measure the value of these waterways at this time when the world is at war and the cause of human liberty at stake?" The Surveyors and Their Charts, Georgian Bay Ships and Sailors, The Great Storm of 1913, The Stately Ships Go On, and Lake Vessels Past and Present—these are the chapters of this part of *Lake Huron*.

It is to be hoped—and a reasonable expectation it is—that the future volumes in this series will be as rich in factual information, as helpful in interpretations, and as delightful in the reading as *Lake Huron* is.

With no lack of appreciation, however, one might venture to suggest just a little bit more of the ingredients of natural history. This, one should hasten to add, has not been ignored by Professor Landon, yet it would seem that other authors in the series might widen the effective reading public of their books and achieve more nearly the aim of being comprehensive if more could be included about the lakes themselves, the fishes that live in them, the birds that fly over them, and the mammals that live along their shores. On these subjects it seems as though there has been a too rigid exclusion of what some readers might consider uninteresting facts, of material lacking in close human associations or of natural history material that is not the subject matter of historians. Whatever the point of view, the exclusion seems too rigid.

When we read of Lake Erie, for example, it will be somewhat disappointing if we do not find more about the fishes and the fisheries than we do in *Lake Huron*. Interestingly enough, when Professor Landon writes about the fisheries he might be described as discussing fisheries of the State of Michigan and of the Province of Ontario rather than of Lake Huron, for he touches on this subject in two places—Along the Michigan Strand, and again in Up the Canadian Shore. The very recently published report of the "International Board of Inquiry for the Great Lakes Fisheries" does now make it possible to see more clearly the problems of this resource from the point of view of the lakes (and the boundary-unconscious fishes in them) rather than solely from that of the separate political land units from which they are exploited and administered. And from such a student of the Great Lakes fisheries as John Van Oosten—Fish and Wildlife Service investigator with headquarters at Ann Arbor, Michigan—it should be possible for the editor and authors of this series to obtain information that will be a further enrichment for us readers.

So also—to continue with Lake Erie as an example—it will be disappointing if nothing is included about the muskrat marshes, the wildfowl areas, the heronries—the whole natural history of the lake. These are for many readers essential aspects of the Great Lakes. And the adventures of men in studying the geology of the lakes, measuring their depths, analyzing their waters, and writing their biologies might be surprisingly interesting. Naturalists, as well as navigators, are part of the human scene of the lakes.

These thoughts, again, are pertinent to other books in the series. *Lake Huron* now, like the universe, we can only accept; and we should indeed be foolish not to do so with appreciation. It is an excellent work, attractively published.

Lake Huron. By Fred Landon. Indianapolis and New York: The Bobbs-Merrill Company. 1944. 398 pp., with 30 photographs on 19 plates, illuminated end-paper maps of the Great

Definition

By ETHEL ROMIG FULLER

Pools are sky's watermark
On the crinkled, brown vellum
Of the landscape.

Lakes and of Lake Huron, bibliographical note, and index. $3.50.

International Board of Inquiry for the Great Lakes Fisheries: Report and Supplement. Washington, D. C.: United States Government Printing Office. 1943. 213 pp. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., 30 cents.

Flora of the Pacific Coast

Illustrated Flora of the Pacific States. By Leroy Abrams. Stanford University, California. Stanford University Press. 1944. 635 pages. Illustrated. $7.50.

This is the second volume of this fine reference work, projected in four volumes, and which, when completed, will constitute the only publication on the flora of the West that illustrates all of the species. It will cover every fern, flower, tree and shrub known to grow wild in the Pacific States. Professor Abrams, who is Emeritus Professor of Botany at Stanford, has devoted more than forty years to the study of the botany of the West. Twenty-five years have gone into the preparation of this work. The first volume covered Ferns to Birthworts and this second volume describes and illustrates 1655 species from Buckwheats to Kramerias. In our review of the first volume we said that it was "of inestimable value to anyone interested in the study of Western wild plants." Perhaps we should substitute for "inestimable value" the word "essential."

Mr. Tompkins Again

Mr. Tompkins Explores the Atom. By G. Gamow. New York. 1944. The Macmillan Company. 97 pages. Illustrated. $2.00.

Dr. George Gamow is a Russian scientist—now on the faculty of George Washington University—who has done pioneering work on the theory of atomic nuclei. Not long ago he wrote a little book called *Mr. Tompkins in Wonderland,* in which a somewhat bemused bank clerk found himself involved in intimate association with some of our most recent and amazing discoveries of physical science. It was a book full of humor, but one that left the reader with information acquired with a delectable sugar coating. Now Mr. Tompkins, happily married, gets involved with the atom with a similar result. This is truly a most enjoyable way of acquiring a nodding acquaintance with current theories in physics of today.

Meet the Stars

Introductory Astronomy. By J. B. Sidgwick. New York. 1944. The Philosophical Library. 137 pages. Illustrated. $2.50.

As the title suggests, this book is designed to be of use to those who wish to learn more of the mystery and majesty of the stellar universe. Its author is a member of both British and French astronomical societies. He writes for the intelligent amateur, and, in an introductory chapter entitled "Why Study Astronomy?", he supplies an eloquent answer to his own question. This appears to be a useful and practical introductory text.

State Park Progress

1943 Yearbook, Park and Recreation Progress. By the National Conference on State Parks. Union Trust Building. Washington, D. C. 64 pages. Illustrated. $1.00.

This is the second time that the National Conference on State Parks has presented a report of the progress and the situation with respect to this important part of our recreational assets. It consists of statements on the progress during the year in thirty-six states as furnished by the park officials. The publication this year includes information on the part these areas have played in wartime, and the contributions they have made to the recreation of men and women in the service and to war workers. Included, also, is a summary of statistics on the areas, expenditures, attendance and other details.

Thus Far

Mankind So Far. By William Howells. New York. Doubleday, Doran and Company. 1944. 319 pages. Illustrated. $4.50.

This volume in the American Museum of Natural History Science Series is the work of an outstanding American anthropologist. It is an extremely readable account—interesting to the layman—of the newest mammal—Man. It deals with man's past, his present, and his probable future at a date as far distant as 1,000,000 A.D. In looking forward to that date, Dr. Howells points out, "an anthropologist has all the advantages over a follower of the turf or the ticker. He puts up no money, and he can be as irresponsible as he likes: he can unloose a resounding prophecy about the future man, happy in the knowledge that when his prophecy comes due he will have been dead for untold thousands of years."

Also Received

While Father's Away. By Geoffrey and Mother. New York. John Day Company. 1944. 122 pages. Illustrated by Elsa. $1.50.

An informal diary, set down with not the least thought of publication, recording what took place at home during the four months father was away on duty as a war correspondent.

20th Century Engineering. By C. H. S. Tupholme. New York. The Philosophical Library. 1944. 201 pages. Illustrated.

Covering aircraft, physics, mechanical power, engineering workshop practices, air conditioning and refrigeration, chemical and metallurgical engineering, electrical engineering, traction and marine engineering of today.

MAKE A *Bond* WITH YOURSELF

to spend your first vacation when HE comes back, in the Black Hills of South Dakota—mountainland of romance, adventure, fun! Save part of your Bonds for it, and in the meantime send for handsomely illustrated booklet describing the Black Hills, Mount Rushmore, and the Big Badlands. Also ask about "living" opportunities in this rapidly growing state. Address

A. H. Pankow, *Publicity Director*
SOUTH DAKOTA
State Highway Commission
PIERRE, SOUTH DAKOTA

BLACK HILLS of SOUTH DAKOTA

★ *Down East* ★

ON AN ISLAND IN MAINE

With the wind nor'west and white clouds flying, the gulls wheeling above the pines and the blue Atlantic below, come relaxation and rest. Rates are $25 to $30 a week, American plan, at the Island Inn on

Monhegan Island
MAINE
Latitude 43°-46′ North
Longitude 69°-19′ West

Illustrated folder on request

SPRING INTO ACTION
at P. M.

Shake the dust from your golf clubs. Bring your riding togs. Indoor sports, too. Farm fresh food. Convenient bus and train service to nearby stations . . . Start spring right; start for P.M. today—with your family. Make reservations early.

POCONO MANOR

HERMAN V. YEAGER, General Manager
POCONO MANOR, PA.

AT CRESTMONT INN

Fun 'n Fine Living for the Family

Whether you seek lazy days in the sun . . . or a busy-every-minute vacation—come to Crestmont Inn. Cooling mountain breezes. No mosquitoes.

• Water sports • Golf • Tennis • Riding • Cycling • Hiking • Music • Dancing • Game Room • Bridge • Kindergartner.

Superb cuisine. Distinguished patronage. 2200 feet altitude. Easy to reach—rail, road. Reserve early. *Booklet.*

THE CRESMONT INN

Wm. Woods, Prop. EAGLES MERE, PA.

NATURE MAGAZINE

PUBLISHED BY THE AMERICAN NATURE ASSOCIATION

To Stimulate Public Interest in Every Phase of Nature and the Out-Of-Doors, and Devoted to the Practical Conservation of the Great National Resources of America

IN THIS ISSUE

June-July, 1944 Vol. 37, No. 6

Cover Design—Rainbow Trout.....Hexom
Nature in Print.....Howard Zahniser 282
Definition (Poem).....Ethel Romig Fuller 282
Contents Noted.....R. W. W. 287
The Fungi and the War.....E. E. Stanford 289
Biology Note (Poem).....Norma T. Stewart 294
Midway's Gooneys and Others
Nell Murbarger 295
The Long-Tailed Weasel.....H. H. Pittman 299
To a Tufted Titmouse (Poem)
J. Charles Tracy 301
Teamwork in Nature.....Ivan T. Sanderson 302
Some Common Amphibia
E. Laurence Palmer 305-312
The Ohio Fox Hunt (Editorial)..... 313
Bird Man of Minnesota.....Virginia L. Dustin 314
The Empty Bird Bath (Poem).....W. F. Jenkins 316
Lion and Lacewing Lore....Edna Peck Atwood 317
Flycatcher Family.....John Lindsey Blackford 319
Weeds (Poem).....Daniel Smythe 320
Youth in the Garden.....Andrew S. Wing 321
June-July Skies.....Isabel M. Lewis 324
The Skies Murals (Poem)....Margaret S. Hosmer 325
Captive (Poem).....Helen Mitchel 325
The School Page.....E. Laurence Palmer 326
Jepsonia Saves for a Dry Time
E. Yale Dawson 328
Bird Memory.....Grace Frankhauser 328
The Brown Booby in Hawaii..George C. Munro 330
Attract if You Would Watch
Gordon W. Jones 332
Under the Microscope.....Julian D. Corrington 334

NATURE MAGAZINE, PAST AND PRESENT, IS INDEXED IN THE READER'S GUIDE IN YOUR PUBLIC LIBRARY

U. S. AND CANADA
ONE YEAR.....$3
FOREIGN....$.75 EXTRA
TWO YEARS.....$5
LIFE $100

A. B. McClanahan, Advertising Manager

ADVERTISING OFFICES

New York 17—295 Madison Avenue
Washington 6—1214 16th St., N.W.
Chicago—203 N. Wabash Avenue
Los Angeles 15—Western Pacific Bldg.
San Francisco 4—Mills Building
Minneapolis 2—233 Radisson Hotel

NATURE MAGAZINE is published monthly, October to May, inclusive, bimonthly, June to September, inclusive, by the American Nature Association. Entered as second-class matter May 31, 1927, at the post office at Washington, D. C., U. S. A., and accepted for mailing purposes at the special flat rate of postage provided for in the United States Postal Act of October 3rd, 1917, and February 28th, 1925.

Publication and Editorial Office, 1214 16th Street, N.W., Washington 6, D. C.

Copyright, 1944 by American Nature Association. Title Registered U. S. Patent Office. Printed in the United States.

THE ASSOCIATION

ARTHUR NEWTON PACK.....President
Abiquiu, N. M.

RANDOLPH G. PACK.....Vice-President
Darien, Conn.

RICHARD W. WESTWOOD.....Secretary
Washington, D. C.

JAMES A. O'HEARN.....Treasurer
South Orange, N. J.

HARRY E. RADCLIFFE.....Business Manager
Washington, D. C.

DR. E. LAURENCE PALMER.....Director, Nature Education
Cornell University, New York

THE MAGAZINE

RICHARD W. WESTWOOD.....Editor
EDWARD A. PREBLE.....Associate Editor
JULIAN D. CORRINGTON.....Microscopy Editor
ISABEL M. LEWIS.....Astronomy Editor
E. LAURENCE PALMER.....School Editor
ANDREW S. WING.....Garden Editor
HOWARD ZAHNISER.....Book Editor
R. BRUCE HORSFALL.....Artist
HARRY E. RADCLIFFE.....Business Manager

SCIENTIFIC CONSULTING BOARD

DR. LELAND O. HOWARD
Retired Chief, U. S. Bureau of Entomology

DR. WALDO L. SCHMITT
Curator of Marine Invertebrates, U. S. National Museum

DR. HARRY C. OBERHOLSER
Cleveland Museum of Natural History

W. L. McATEE
Technical Adviser, U. S. Fish and Wildlife Service

C. W. GILMORE
Curator of Vertebrate Paleontology, U. S. National Museum

DR. PAUL BARTSCH
Curator of Mollusks, U. S. National Museum

DR. EDGAR T. WHERRY
Wild Flower Preservation Society

DR. WILLIAM M. MANN
Director, National Zoological Park

To make vision comfortable and clear, Ray-Ban lenses filter out ultra-violet, infra-red and glare, transmit to the eyes the rays of light useful for seeing.

Scientific glare protection... for your flyers

When your boy starts on a daylight bombing mission, or gets into a fight above the clouds, he needs more in front of his eyes than "colored glasses." He needs safe, scientific protection from punishing glare—lenses that filter out ultra-violet and infra-red. Ray-Ban Sun Glasses give him a cool, sharp, instantly clear view of enemy landscape or enemy planes.

Ray-Ban is the name of a type of glass created by Bausch & Lomb for exactly that sort of performance, and made to government specifications to meet the needs of American military aviation. For twelve years Ray-Ban lenses and Ray-Ban Sun Glasses have been used to equip the Army and Navy. And thousands upon thousands of civilians have found in Ray-Ban's comfortable, scientifically correct glare protection the perfect answer to eye distress, the ideal glass for outdoor wear.

Ray-Ban visual comfort and efficiency will be available to more millions—after Peace. For today, with Ray-Ban production at a record high, all are going for military use. Along with Bausch & Lomb binoculars, anti-aircraft height-finders, photographic lenses, eye-examination instruments, industrial optical equipment, Ray-Bans are helping to arm the Allied Nations for Victory.

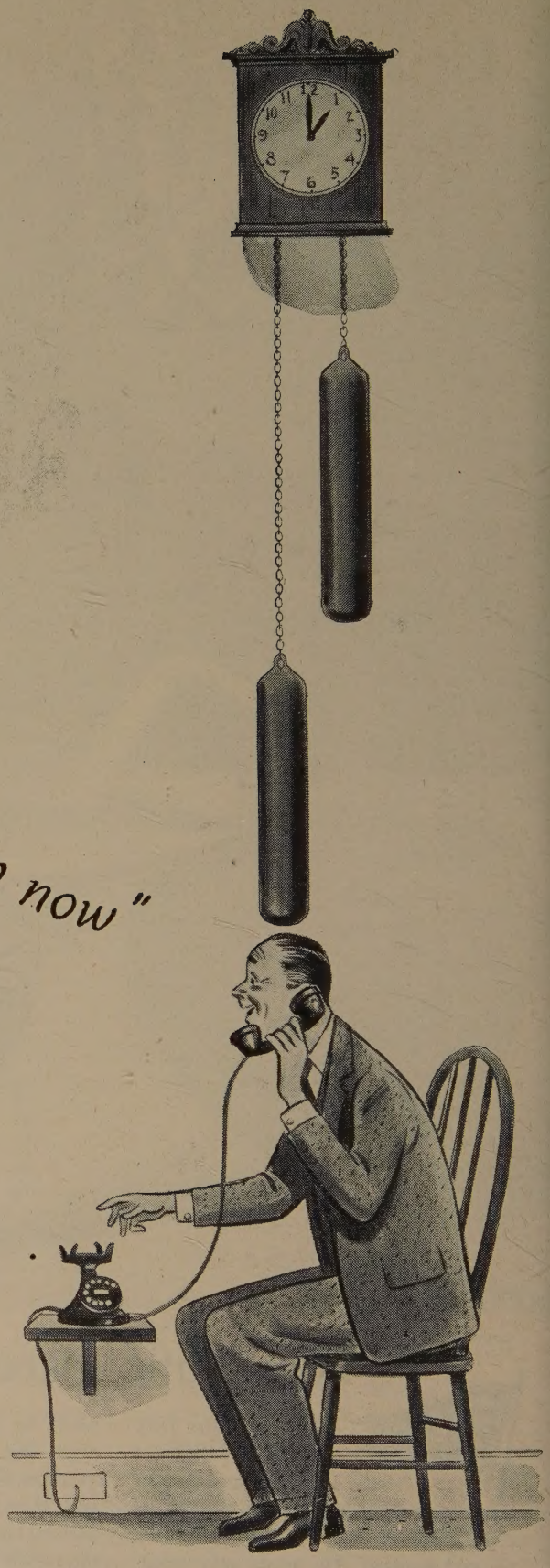
Here, again, optical science is *seeing it through.*

BAUSCH & LOMB
OPTICAL CO., ROCHESTER, N.Y.

ESTABLISHED 1853

Makers of Optical Glass and a Complete Line of Optical Instruments for Military Use, Education, Research, Industry and Eyesight Correction and Conservation

"I think I'd better stop now"



When Long Distance Says—

"Please limit your call to 5 minutes"

That's a good suggestion to follow. It means the lines to war-busy centers are crowded. It's a friendly, thoughtful act that helps the other fellow—and then some day turns right around and helps you.

BELL TELEPHONE SYSTEM

Contents Noted

Viewing all the vast and inexcusable waste of war, one can take slight solace now and then that some technological developments of value will be born of wartime demands. They are far from worth the awful price, but there will be a few black entries among all the red in the ledger of Mars. For example, many canoe paddles are normally made of solid ash, now a highly critical material. The demands of amphibious warfare created a need for more paddles than could be supplied. So Gamble Brothers, a Louisville woodworking firm, was commissioned to produce paddles made from laminated hardwoods. The result is a paddle stronger than solid ash and no heavier. Not so reassuring for our post-war wildlife is the development of control of light loss in gunsights and spotting scopes by International Industries, Ann Arbor, Michigan, precision instrument manufacturers. This is achieved through use of a new type of low-reflectance film calculated to extend the hunting day. This device, however, will aid camera users, virtually eliminating "ghost" images when pictures are taken in bright light.

Back in our younger days there was a popular song called the "Yum-yum Tree," sung, we seem dimly to recall, by Bessie McCoy—or was she only the "Yama Yama Girl?" Anyway, an horticultural partnership is now being concluded that would appear to bring the yum-yum tree to life. U. S. Department of Agriculture specialists working in Puerto Rico are concentrating on developments that will aid the island's farmers. The vanilla offers possibilities in this direction, but this climbing orchid, which needs both support and shade for good growth, has been depending on a tree that often loses its leaves in hot, dry weather, just when the shade is most needed. So the experimenters have been letting the vanilla entwine on the cashew tree, with excellent results. Do not, however, count on a yum-yum tree for your back yard. Both vanilla and cashew are tender tropical plants.

Fishermen, fish dealers and marine biologists have often wrinkled their brows about the fluctuations in the annual catch of mackerel. It has varied by as much as one hundred million pounds within a few years. A low for the Atlantic Coast mackerel fishery was 13,000,000 pounds, and a high—in 1884—was 234,000,000 pounds. Oscar Elton Sette, eminent marine biologist, set out to find an answer. He towed fine-meshed nets through surface waters between Cape Cod and Chesapeake Bay. He gathered the eggs and larval stages of mackerel to determine the major spawning areas and the relative survival of the young. For one year he found that only about one young mackerel survived for every 100,000 eggs spawned. That year microscopic surface life that served as food was scarce, and prevailing winds created surface currents that swept the young away from their normal nursery. A few years later there was a poor catch. Sometimes unfavorable conditions may obtain for several years and result in a series of depression years. All this is to provide a basis for reckoning the size of spawning stock reserve necessary to maintain a high production of the mackerel fishery. Being an enthusiast for a nice baked mackerel, this makes us very happy.

We have met a lot of sportsmen to whom the adjective "dyed in the wool" could be applied, but a new high is established by a nimrod who advertised in the Cedar Rapids (Iowa) *Gazette*. His classified ad read: "Wanted—Single man wishes to correspond with single lady with two boxes of 12-gauge shells. Object: matrimony."

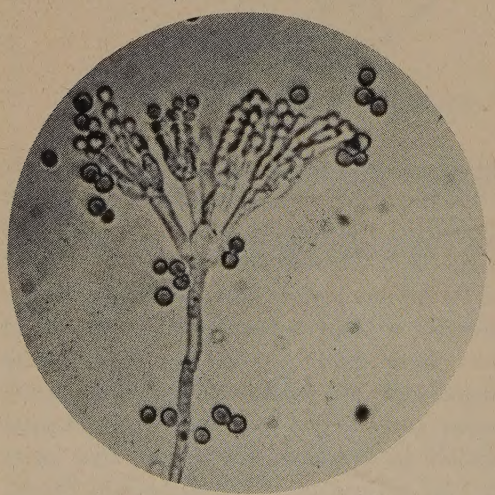
Students of the psychological problems of morale have added a new adverb to the vocabulary through a booklet presenting the results of their studies and bearing the title "A B C's of Scapegoating." The word is defined as "a phenomenon wherein some of the aggressive energies of a person or group are focused upon another individual, group or object; the amount of aggression and blame being either partly or wholly unwarranted." The contents of this 72-page pamphlet, which is available for twenty-five cents from Central YMCA College, 19 South LaSalle Street, Chicago, Illinois, are stimulating; its evaluation of human predilections, prejudices, discriminations, and, finally, scapegoating is vitally important. An honest reading of this booklet, coupled with an honest session of self-searching, would do a lot of Americans and the future of our country an immense amount of good.

R. W. W.

PHOTOGRAPH BY MARGARET BOURKE-WHITE, COURTESY OF YORK CORPORATION

PHOTOGRAPH FROM E. R. SQUIBB AND SONS

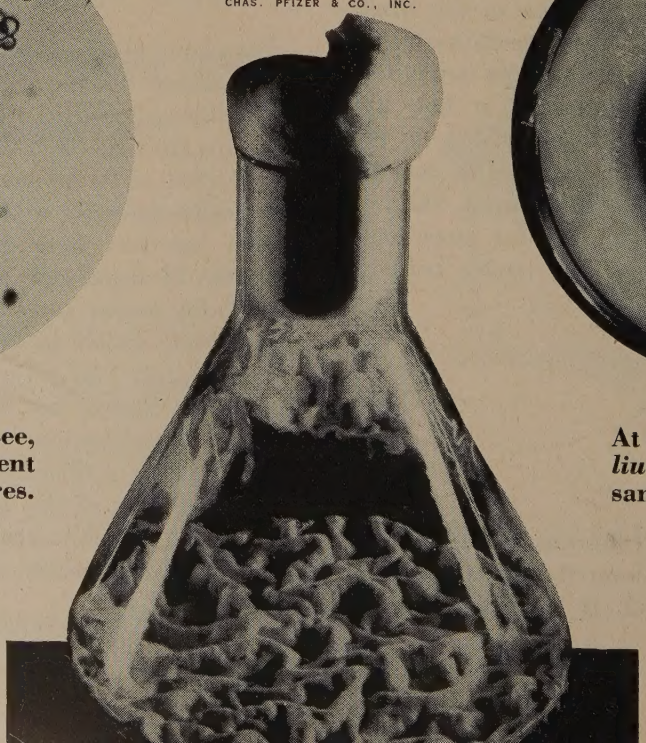
An enlarged picture of the velvety growth off *Penicillium* (above) shows the penicillin as droplets on the surface. This has been called the "dew of mercy." At the left, looking much like a tam-o-shanter, is an enlarged picture of the fuzzy mass of fungus hairs that produces penicillin. In a bacteriological Petri dish below a dense growth of staphylococci have formed a halo around a growth of the *Penicillium* fungus, which has, in turn, prevented the growth of the bacteria in the dark rim around it. An observation of this sort in the late 1920's led to the discovery of the value of penicillin in treating wound infections and many other diseases.

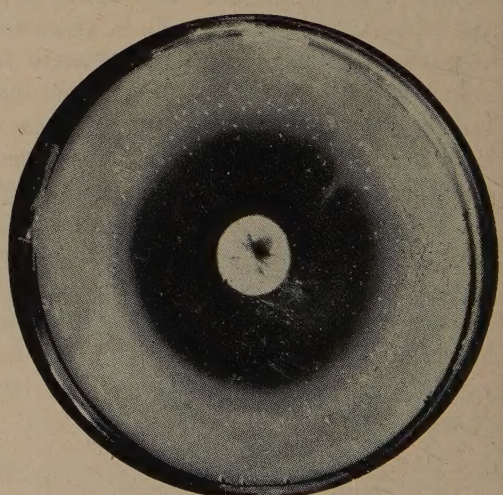


PHOTOGRAPH FROM E. I. DUPONT DE NEMOURS

Under the microscope we see, above, a branching filament of *Penicillium* bearing spores.

PHOTOGRAPH FROM CHAS. PFIZER & CO., INC.





PHOTOGRAPH FROM E. R. SQUIBB AND SONS

At the left in the flask *Penicillium* grows in culture, the same mold seen top of page.

The Fungi and the War

★

Plant disease fungi destroy crops and ruin other vital products, but others are doing great war work.

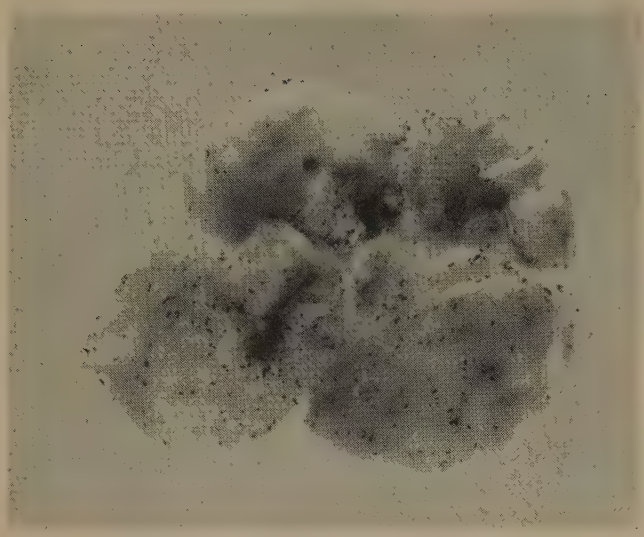
By E. E. STANFORD

AMONG the oldest enemies of man are the fungi. Little doubt their thread-like fingers crumbled the rude timbers of his first wooden house. Their parasitic shock troops rusted and blackened his grain crops when these were yet wild grasses, chance-sown and chance-plucked. Grapejuice spoiled by submerged little blobs of them shamed Noah; they may have incited the quarrel of Cain and Abel. Through the ages the fungi have been quite impersonal about all this. Like the rain (whose moisture often aids them) they fall upon the just and the unjust. They blight impartially the rice fields of Hirohito, the struggling rubber plantations of Brazil, the corn that fattens lend-lease hogs, the potato patches of Schickelgruber. Yet they are capable of better things. Should their transformations suddenly stop, the litter of death in field and forest would remain merely dead, its substance useless to present and future life. They flavor our cheeses. They leaven our bread. Even their alcohol has its proper uses. And a mold provides perhaps the most valuably surprising material of modern medicine.

Our most familiar fungi, perhaps, are the mushrooms, whose varicolored tents rise from lawn and woodland. Yet these are only a few among thousands of fungi, most of which live and die unseen, invisible in their effects, microscopically perceptible as tiny tangling threads in slender tubes of decomposing wood-cells, or in the ruins of prismoids Nature-built in leaves to make sugars and starches. You see films of fungi on whiskery bread crusts in the garbage can, on poorly-sealed jams of yester-year, on spoiled squashes. The housewife says "mold." The scientist dives in with a microscope, and comes up with *Aspergillus, Penicillium, Rhizopus,* or *Cephalothecium*—Greek sounding names for living things the Greeks had no words for.

When fungi destroy what we wish to save, we grumble. In war, food destruction links itself with starvation. But we have long known that fragments of organic destruction may have uses and values the parent substances lack. We are beginning to realize that fungi, like all living things, construct as well as destroy. The war has involved nearly everything—"animal, vegetable and mineral"—and is not getting along without the fungi. A comprehensive although incomplete cataloging of wartime fungus significances might include destruction by plant diseases, rots and mildews of economic products, fermentations yielding alcohol and other "organic" materials in industrial chemistry, and lifesavers—realized or potential—such as penicillin. And we might even find that single species contribute to several of these categories, and that the categories themselves overlap. Through disease of growing plant and rot of product, fungi forever threaten our food supplies. Wars kill with clattering tanks and crashing bombs. Plant diseases bring silently the pallor of famine and shrinkage of skin over skeletons, living and dead. The potato blight, which starved thousands of Irish in the 1840's, sent other thousands to build the railroads of our prairie West and take over the politics of Tam-

Graphic indication of what rot-fungus filaments do to strategic wood. This photomicrograph from the U. S. Forest Products Laboratory shows the destructive fungus at work in vital Douglas fir lumber.



In studying the fungi that mildew fabrics, scientists force them to grow as these little black dots on previously sterilized cotton fiber. Photograph from the U. S. Department of Agriculture.

many and Beacon Hill. The poisonous ergot, which grows on rye, killed Europeans all through the Middle Ages. Now it is generally removed from human food. It has even valuable medicinal and surgical uses. But, growing on grasses, ergot still kills domestic stock from the Texas Panhandle to New Zealand.

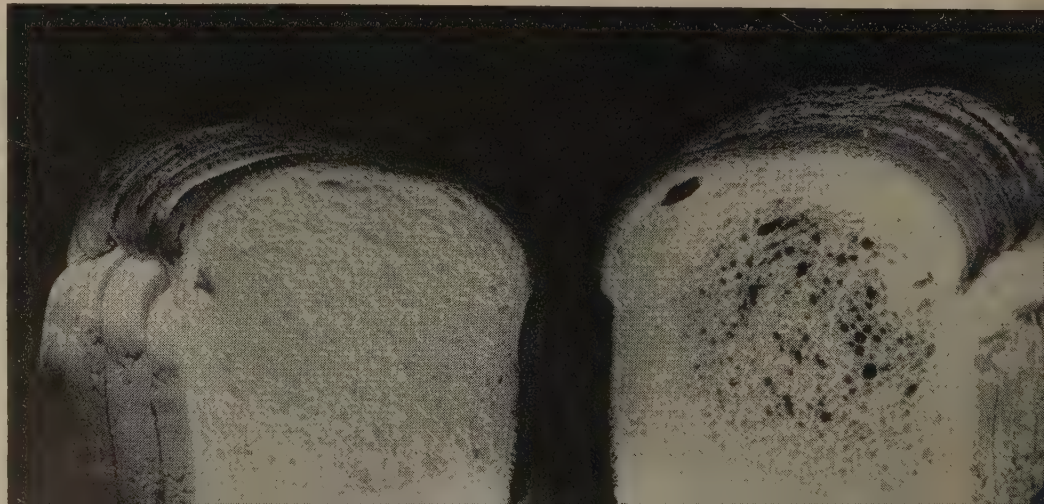
Probably no crop plant or forest tree lacks its fungus enemies, and some of them have dozens. Fungi get into the tubular water-carrying cells of leaves and stems, and the plants wilt. Rusts crack open the stalks and foliage of cereals, which dry out and parch in the prairie winds. Smuts turn grains into ill-smelling sooty messes. Fungus spots spoil the manufacturing cells of leaves. Blights and mildews crumple and disfigure foliage. Rots make mush of apples, tomatoes and soft fruits in general; they spoil stored potatoes, and addle the odors of onions in their sacks. Cankers spot green stems and girdle living trees. Wood-rotting fungi injure forest trunks, and even cut out their hearts. The actual causes of all these troubles rarely meet the naked eye, but they do get around. Handle a piece of moldy bread, or an orange with that too-familiar bluish-green soggy sunkenness. An almost impalpable powder will dust your fingers and drift invisibly into the air. Particles of this dust become, under the microscope, nearly transparent glistening balls or ovoids. If they are average mold spores, several thousand laid end to end might measure an inch.

Watch such spores in slightly sweetened warm water. One end soon bulges into a thread that branches and rebranches eventually into a tangled mass visible to the naked eye. As it matures, this fungus mat bears more spores in chains, spreading finger-formations, or ball-like heads, depending upon the kind. A mushroom or a bracket fungus on a tree affords spores in literal billions. The number on one rotten orange can be expressed only in World-War-mathematical figures.

From visible and invisible sources, spores get into the air, and then they get around. They germinate on moist surfaces, in dewdrops on leaves, the family washing too long in the rain, stale bread in the tin box, baby's shoe put away for a keepsake, skin between the toes. Few if any fungi would grow in all such places. Common molds thrive on a huge variety of things; potato blight ruins only potatoes. There are enough of plant disease kinds, and they damage a lot of valuable crops. In 1940, the last year for which the Government has furnished figures, plant diseases, mostly fungi, cost us nearly 200,000,000 bushels of corn—8.6 percent of our crop; 60,000,000 bushels of potatoes—an 18.2 percent loss; 44,000,000 bushels of wheat—6.3 percent of the production. We lost 24.5 percent of our canning tomatoes—412,240 tons of juices rich in vitamins.

Farmers, plant pathologists, and experiment station workers do not take this sort of thing sitting down. To save crops, for us and for the world, they have attacked fungi on several fronts. They have developed resistant varieties. A large percentage of canning tomatoes come now from a stock that, thanks to "blood" from a currant-sized South American strain, resists a wilt that drops ordinary tomatoes as though scalding water had rained on them. Flax in the Dakotas—one of our oil-seeds whose production we are trying to boost—might years ago have died out save for development there of wilt-resistant strains.

Another main line of plant disease attack—and one that the war has considerably affected—is the use of



Both these loaves of bread are five days old. The one on the left contains propionates, or salts of propionic acid that discourage the growth of molds. The bread at the right lacks any such protection and is already darkened by the growth of fungus. DuPont photograph.

The tell-tale white streaks in this piece of rotten timber are mats of fungus threads. Thus can fungi sabotage the war effort. Photograph from the U. S. Bureau of Plant Industry.

fungicides. Sulphur dust keeps mildew from roses and grapevines. Copper and mercury compounds treat potato tubers, seed grains and seeds in general. Copper sulphate and lime, in unsightly Bordeaux mixture, plaster peach trees against leaf curl and brown rot, potato vines against the blight that devastated Ireland, and likewise protect field and garden crops, like the miscellanies of the auction bills "too numerous to mention."

Now, copper and mercury have gone to war. Supplies for the farmer have been cut, although in some parts of the country, plant pathologists report, their loss has not so far been seriously felt. But further cuts are predicted for the coming season. More serious, from most accounts, has been lack of machinery and manpower to do the spraying and dusting properly and at proper times. Once established, fungi may spread like wildfire. A few days' delay in spraying—from a lost (perhaps irreplaceable) machine part, may bring disaster.

Other countries, to be sure, are worse off than we are. Lack of fungicidal copper has havocked the banana plantations of Central America. This, it is said, has accelerated their turn-over to Manila hemp we sadly need for marine cordage. Before Mussolini left so hastily, his men were reported to be recovering copper from long-sprayed Italian vineyards at the rate of five pounds per acre. This copper, we may guess, was not intended to go back on the vines. How much the fungi that injure us at home have profited by war's results to damage Axis crops, we shall know only after the war.

While the search has attracted less attention than that for replacements of the insecticides that we lost with the Orient, our plant disease scientists are searching busily among possible substitutes for copper and mercury, and devising more economical means of applying what of those we can still spare for killing fungi. Some smuts and other disease fungi spread through contaminated seed, and soil fungi often attack healthy seed in the soil. Plant pathologists now are stressing seed treatment—often the most efficient means of applying a fungicide. Ingenious mixtures glue suitable poisons on seeds. Poisons as a rule are not mailable, but the American Phytopathological Society told the Postmaster-General that such fungicidal treatments may prevent diseases that sometimes reduce crop yields as much as seventy percent. So he quickly consented to let such treated seeds go through the mails to farmer and Victory gardener.

Disease-resistant breeding and dusting and spraying have done little enough in the forest. Blister rust, introduced from Europe before World War I, has girdled hundreds of thousands of white pines and has prevented the planting of thousands of acres more. Remains of Appalachian blight-struck chestnuts tan leather for army shoes—but we would rather have had the trees for ties and posts and timbers; we could have tanned the leather from other materials. Hidden heart-rot damage forces discard of thousands of feet of white oak timbers sent to Atlantic and Pacific shipyards. Rots also damage the Douglas fir for shipyard and army housing and plywood. Sitka spruce for airplanes; yellow birch, yellow poplar, South American mahogany, and African khaya for airplane veneers and sides and decks of PT boats, all suffer from rots, and also are discolored by alarming looking sap-stain fungi, which fortunately do not seem to lessen strength of wood. From Ecuador, balsa gets

If the fungus or mold on the bread is put under the searching eye of the microscope, it is revealed as a lusty, forest-like growth that is rather pretty but certainly of no help to the "staff of life." The activity of fungi can thus destroy much vital food. DuPont photograph.

first priority when ships are loaded—and one of the main problems of production of that strategic and sappy wood is to season the water out before the rot fungi get in. Here and there over the country, new plants and old are fungus-proofing the wood that replaces steel ground members and fire-proofing forest-born girders. The United States Department of Agriculture reports that, in 1941, nearly 301,000,000 cubic feet of wood were pressure-treated with creosote and allied compounds to discourage insects and fungi. A creosoted railroad tie, for example, may last thirty years, while an untreated one rots out in five. But any one who has seen some of many hastily-thrown-up army cantonments, office buildings and jerry-built defense housing developments, knows that there are plenty of places where termites and dry-rot fungi will presently have their innings.

While some fungi rot wood, others affect cotton, linen or wool. These are of special significance on ships and lifeboats. Such molds grow apace on land and sea in hot, steamy climates. In New Guinea, for instance, where jungles hide the fungicidal light of the sun, mildewed tents, sleeping bags and hammocks would spoil rest for the battle-weary soldier, and rotted mosquito nets might let in the malaria-bearing mosquitoes, which rank with war's worst hazards anywhere. There are portentous sounding compounds that inhibit these cloth-mildew fungi without injuring the cloth or those who use it.

Fortunately, relatively few fungi attack the human species directly—although in 1943 the army had some 75 cases of primary pulmonary coccidiomycosis—a horrific sounding disease that occurs mostly in California, with occasional fatal results. There are pathogenic yeasts, too, and other human disease fungi, largely of the tropics, of which the Services will say little save that appropriate protective measures are being taken.

Speaking of yeasts, if those so-called degenerate fungi were to go on a sit-down strike, there would soon be no more war. Under the microscope, yeasts are pearls, although neither of great size nor great price. There are some twenty to twenty-five billion in a four-cent cake of compressed yeast. We might get along with unleavened bread, and many war-plant officials plagued with accidents and absenteeism do not list alcoholic beverages as aids to the war effort. But in an average pre-war year before we went in for volume in explosives or even thought of large-scale synthetic rubber—we totted up 100,000,000 annual gallons of industrial alcohol. It was mostly bubbled up by yeasts from blackstrap molasses—and some from grain—with a little synthetic supplement from petroleum. Forecast for the year ending June 30, 1944, is nearly 500,000,000 gallons, an increase of 400 per cent. Grain—even wheat in huge quantities—as well as molasses, is pouring into the fermenters. Crop wastes, sawdust piles, wood pulp residues, and Heaven knows what besides, will have to do their bit, and there will be more busy yeast plants than the world ever saw in harness in any half dozen years before Pearl Harbor. The whisky people are making nothing but alcohol. The little yeast plants are really working for the war!

While we are making less alcohol to drink, we are making more yeast product to eat. Yeasts, properly used, have dietary values and have made themselves useful in vitamin therapy. They are largely employed, for example, in pellagra, a disease that shadows starvation, war-caused or not. Yale University—whose football teams never needed it—has developed a strain of yeast remarkably rich in riboflavin, one of the scarcer vitamins. Yeast runs high in thiamin, B_1—the "morale vitamin,"—too, although well fed Americans hardly need a yeast cake every time the war news takes an unfavorable turn.

Yeasts make alcohol by destruction of sugar and from other less promising plant sources. They are even beginning to make it from waste from paper mills—than which no more troublesome refuse ever contaminated good fishing waters before the war. By construction of a most complicated sort, yeasts also make protein. In both England and America yeasts

The single little yeast cake does not bulk large, but the commercial production of the vital yeast is a huge-scale operation, as we may gather from this scene photographed in the Fleischmann Laboratories.

By the time these spore-bearing brackets appear, a tree trunk is useless for war-vital lumber. Wind carries millions of spores from the brackets to do further damage. Lustin E. Martindale.

and torulae, which are much the same thing, are being fed with sugar and ammonia to turn out a protein product that in food value resembles meat. Just on principle most Americans would prefer a twelve-point steak. From enthusiasts who have looked into these matters come astonishing stories. In any bacteriology text, you may find a paragraph to the effect that a single bacterial cell, multiplying unchecked at the rate of once every twenty minutes, would generate in a week a mass larger than the earth. Yeast cells are larger than most bacteria and they reproduce, under optimum conditions, almost as rapidly. While we are not likely to give them food enough to crowd our global war off the map, what seem to be reliable reports indicate that 125 pounds of torulae growing in sufficient sugar solution overnight will produce a ton of meat substitute in the morning. A big establishment is being started to do this in Jamaica, where labor is cheap and molasses something like six dollars a ton. To cheer the stockman and the baby beef finisher, these people in Jamaica, and brewing concerns interested in American production, say that a ten-foot vat can produce as much yeast "meat" in a year as ordinary livestock could build on a thousand acres of pasture. They figure on a selling price of ten cents a pound. (How many ration-points, has not yet been decided.) And any ten-cent-a-pound protein product would interest not only the beef people, but the pork producer of the Corn Belt, the sheepman of Idaho, the poultrymen from New Jersey to California, and the fishermen on all the seven seas. If any of them rise to say that yeast does not taste good, the yeast people come back with the news that de-bittering processes are being perfected, and that yeasts are even being bred for flavor. One may discount a lot of the advance-publicity stuff, and still project hopeful thoughts of what food-yeast may mean to a war-impoverished world.

The Nazis, it is safe to say, know as much about food-yeasts as we do. Pioneers in fixing nitrogen from the air, yet always short of protein food, it seems a good guess that they can find all the ammonia their yeast-vats may need. Germany is lacking in the sugars and molasses we use for yeast-feeding, but one report indicates that she is producing 100,000 tons of edible yeast per year from wood.

In the first World War, Germany produced fat and glycerine from yeasts and other fungi—and of fat, of all foods, continental Europe is shortest. Devious reports come of similar syntheses in this war, and we may be sure if they do not cost more in calories and essential materials than they are worth, these processes are again being intensively developed by the Nazis. For ourselves, we still have butter (at 12 points per) as well as guns, and glycerine from cottonseed and soybeans and slaughter-house and kitchen wastes and fish oils.

As makers of alcohol, yeast fungi are the great prime movers of this fermenting world, but their abilities are shared by several filamentous fungi of the black mold and the green mold groups that destroy bread and cheese in the pantry. Some of these are being used in conjunction with yeasts in industrial alcohol fermentations. Japanese sake is a fungus-made beverage from rice—and we hope presently to convince Tojo and his kinsmen that they had too large a load of it when they started their war.

Fungous fermentations produce other chemicals besides alcohol. Often sugary things that have been fermented taste sour. This sourness is due to a variety of acids, some familiar, others known only to research chemists. A few years ago gluconic acid was one of these last. Research men harnessed fungi into making it, a little at first; now in quantity. Calcium gluconate is now a staple of remedial feeding for infants, invalids, and hospital cases who need the blood and bone-building values of lime. Recently it has cured a couple of cases of Epsom salt poisoning—whose symptoms were as bad as the cause suggests.

A better known acid is citric which we used to get from Sicilian lemons and use in photography and soda-pop. Fungi make that, too. Some years ago, an American firm was said to have "nine acres of *Aspergillus niger* to supply the enormous amount of calcium citrate required by the cheese industry." Do you remember the early days of "defense" when we were

urged to eat more cheese, and still more cheese as meat became scarcer? The British and other lend-leasers heard this propaganda, it would seem, and very soon American cheese grew points also.

Old World cheeses, such as Camembert and Roquefort, owe flavors, odors, and characteristic colors to mold growths visible in their pores. American dairy biochemists, characteristically, have approached the problem of mold-use in cheese-making in slightly different fashion. Mold acid may flavor cheese, and yeasts may leaven bread, but these and other easily digestible foods are often themselves destroyed by fungi. To hold this damage in check, thousands of pounds of propionates are used by bakers and cheese makers. Propionates—propionic acid derivatives—are themselves made by some micro-organisms, but chemists form them more quickly in large-scale syntheses without micro-biological aid. In foodstuffs, propionates inhibit mold growth for a time but not indefinitely—and that inhibition is more than ever worthwhile nowadays when bakers' wagons come infrequently and bread stays on grocers' shelves until somebody buys it or the "whiskers" of mold attest its age. Soldiers, too, can hardly expect fresh bread every day, and ours may thank propionates that some of the bakery stuff they do get is still edible.

Alcohol, organic acids, and various less understood products of micro-organisms seem to be waste products of vital processes, and their accumulation tends to slow up, and eventually to halt, the growth of the fungi that form them. Sometimes they act even more dramatically on other living things. When a lot of living things — bacteria, fungi, algae, protozoa — swarm together in soil or water, any means, metabolic product or otherwise, which one organism can produce to retard another is naturally of advantage to the first in the "struggle for existence." While fungi do not think these things out and then devise bactericidal poisons, some of them do have the poisons. The story of this offensive self defense—antibiosis—is one of the most fascinating of the newer chapters of biology, and it promises to be among the most significant.

For years, bacteriologists and mycologists noticed that when strange bacteria or fungi contaminated their cultures, the organisms of the original growth sometimes disappeared. In 1929, six years before the sulfas burst into view, Alexander Fleming published in a British medical journal an account of an experiment in which a growth of a *Penicillium* appeared in a culture of staphylococci, whereupon the staphylococcus colonies in the neighborhood began to dissolve and disappear. Staphylococci are spherical bacteria growing in bunches. They involve themselves in various kinds of unpleasantnesses—food poisonings, boils, abscesses, carbuncles, wound infections, osteomyelitis, septicemia and other infections that are fully as bad as they sound. *Penicillium* is a group-name for various slow-growing, green and blue powdery fungi that appear on stale bread, rotten apples, moist fabric, leather, and other odd places. Forest soils are often full of them—and when they are, their bacterial count is generally low. It was evident that this particular species — *Penicillium notatum* — of Fleming's produced something that, diffusing into the culture, destroyed the staphylococci. Fleming named this substance penicillin, and he described a variety of experiments that demonstrated its inhibitory power on staphylococci, and also streptococci — bead-strung bacteria of even more dangerous nature. Some bacteria—ordinary intestinal forms and typhoid bacilli—were unaffected. Injections into animals and surface experiments on human subjects indicated penicillin to be non-toxic.

In spite of this pre-view of its possibilities, penicillin attracted little attention for several years. Until the sulfas came along, few people believed that any substance strong enough to hamper bacteria could be safely used in the human bloodstream. Of a list of 81 papers on penicillin published up to June, 1943, 60 had come out in that and the previous year, and only 7 were dated prior to 1940. In the shadow of the sulfa drugs, however, work with it went on. Recently, and centering largely about its production for war use, there has been a sort of tidal wave of publicity over penicillin. While it is no cure-all for every bacterial trouble, it seems to have wider usefulness, tremendously more power, and less danger of toxicity than the sulfas. Penicillin, in short, is "good copy," and has quite stolen the show from the sulfas. Manufacturing houses and government agencies have gone all out for making this substance, whose chief limitation, it would seem, is the slowness of growth of the fungus and the infinitesimal amounts of bacteriostatic substance it produces. Every published notice of penicillin seemed necessarily to wind up with the statement that none is available for civilian use. But with all the biochemical engineering brain-power now being focussed on it, this discouraging addendum is now gradually being dropped.

The success of penicillin, of course, stimulated research for other fungus products that might be just as good, easier to produce, or even better. Penicillin can not handle malaria; sulfas are of some value, and we could use something better than quinine or atabrine—if we had it. Neither penicillin nor the sulfas, for example, are of much use in the virus diseases. Dozens of fungus kinds seem to offer nothing worth while; some species of *Penicillium*, in fact, are quite lacking in the prop- (Continued on page 329)

Biology Note

By NORMA T. STEWART

Amoeba moves in manner odd,
By stretching forth a pseudopod,
So though it's just a tiny dot,
He (she) really gets around a lot.

Midway Island gooneys remain unconcernedly on nests while oil tanks, fired by Japanese bombs during the battle of June 2 to 6, 1942, burn furiously. This avian nonchalance is characteristic of these interesting birds. Official U. S. Navy photograph.

Marines and construction workers are companions and friends of—

Midway's Gooneys and Others

By NELL MURBARGER *(as related by Vance O'Brian)*

MIDWAY ISLAND, as a cable station, while not a part of the Hawaiian Bird Reservation, actually has been a bird refuge through the interest in birds of those stationed there. Lying some twelve hundred miles northwest of Honolulu, the island is little more than a pin-prick in the vast domain of the Pacific. A mile long and half as wide, low-lying and composed of white coral sand, it has no natural water except the usual rainfall. Clumps of *Scaevola lobelia,* locally called beach "magnolia," a low shrub, are scattered over the island, and with occasional tussocks of grass serve to relieve the monotony. Here, every season, thousands of sea birds nest and rear their young. Midway's first families, its blue-blooded aristocracy, are the gooney birds, or Laysan albatrosses, *Diomedea immutabilis.*

The first unfortunate navigator to crash his bark on the island shores doubtless found a poker-faced gooney waiting to greet him. Should the time ever come that the last man-made structure is swept into the sea, leaving the island as desolate and forlorn as it began, there doubtless will be another solemn gooney watching it go.

Gooneys are picturesque creatures, as large as barnyard geese, with snow-white neck and breast, dark gray back, intelligent shiny eyes, powerful hooked beak and big flat feet that go plop, plop, plop as the bird waddles along.

There have never been any other birds on the island large enough or powerful enough to harm the gooneys. As a result, they have developed an attitude of superiority and lack of fear for everything that walks, crawls or flies—including Marines, trucks, tanks, pursuit planes, caterpillar tractors and pile drivers. They take life as it comes, without even quickening their stride.

It was while employed on the island during prewar years that Mr. O'Brian made the acquaintance of the gooney clan. To say that it was an intimate acquaintance is the height of understatement, because the greater part of the year there were so many gooneys in Midway that they literally got in one's

hair. Many thousands of them made their home and nested on the island from November to August; by actual count there were 2000 nests on the Pan-American Airways compound, alone.

Although master of all he surveys in the air, the gooney presents an ungainly, comical appearance while on land. He waddles along, ducking his head, mumbling to himself and slouching from side to side with every step. Like an airplane, he requires a long runway into the wind. Only with a strong breeze blowing can he rise from the ground within twenty feet, and in calm weather must run for a hundred yards or more before attaining sufficient speed to take off.

Always polite, the Midway gooneys would rise and bow whenever a man passed near. Some were extra friendly and might be slowly approached and petted, or the side of their necks or cheeks might be scratched. They loved this attention and would stretch their necks in various directions to facilitate matters for the scratcher and thus keep him scratching as long as possible.

For all their apparent amiability, gooney-petting was fraught with some danger. Temporary residents were many times warned that, if they must pet gooneys, to use the utmost care never to make a quick move when around them. When the bird was startled its powerful beak might severely pinch a man's finger, or even make a flesh wound. It was easy to heed such a warning after seeing the birds use their beaks to tear apart live squid and cuttlefish.

Gooney nesting season begins in November. Just as some people are ambitious and neat and others slovenly, so do gooney natures differ. Some of them build a nice, crater-like mound for a nest; others simply kick a depression in the sand. In either case the ultimate result seems to be about the same.

Mrs. Gooney is capable of laying only one egg a year. If this is destroyed at any time during its sixty-three day incubation period, all is off until another season. Even after hatching, it is estimated that less than sixty percent of young gooneys live to maturity. Yet the colony shows no signs of diminishing.

The egg-laying process must be somewhat of an ordeal, as the egg is eight or nine inches around and weighs a half-pound or more. As soon as it is dropped, the gooney hen feels it all over with the tip of her beak and talks to it in low, motherly tones.

Before long the male comes home, shoves her off the nest and takes over. The incubation period is divided into shifts, the parents taking turns and each sitting on the egg for fifteen or eighteen days at a time, during which stretch little food is taken. If the mate fails to return to take over his or her shift at the proper time, it is said that the nest tender will continue to sit on the egg for a month or more without either food or water.

After the egg hatches, one of the adult birds is reported to continue to cover the chick for another ten days. Probably rarely in the animal kingdom is there to be found a creature so utterly appealing and whimsical as a baby gooney. Left alone in his makeshift nest at an early age, with his parents away at sea most of the time, the fat little down-covered chick "stays put"—although the heavens may fall. No one but the basest pariah would think of harming the helpless little fellow. Because of this fact, I presume that pre-war construction work on Midway was delayed more man-hours than Washington will ever know.

Caterpillar tractors were used extensively in the work being done, and since much of the island was literally peppered with gooney nests during a considerable part of the year, a guard would have to be sent ahead of each tractor to move the baby gooneys to one side. As soon as the tractor had safely passed, the guard would set the chick on the ground and hurry ahead to pick up the next one. As soon as the first chick was released he would scuttle back to his nest and serenely compose himself, ready to be moved again by the advance guard of the next tractor that came along.

And so it went. It may sound silly, but I do not believe a single "cat skinner" on Midway would intentionally have killed a baby gooney for a ten-dollar bill.

From the time of hatching until the young gooney is about six weeks old, its parents return periodically to feed it by regurgitation. This looks like a painful operation for the adult, unpleasant for the baby and thoroughly distasteful to the observer. However, it seems to be customary.

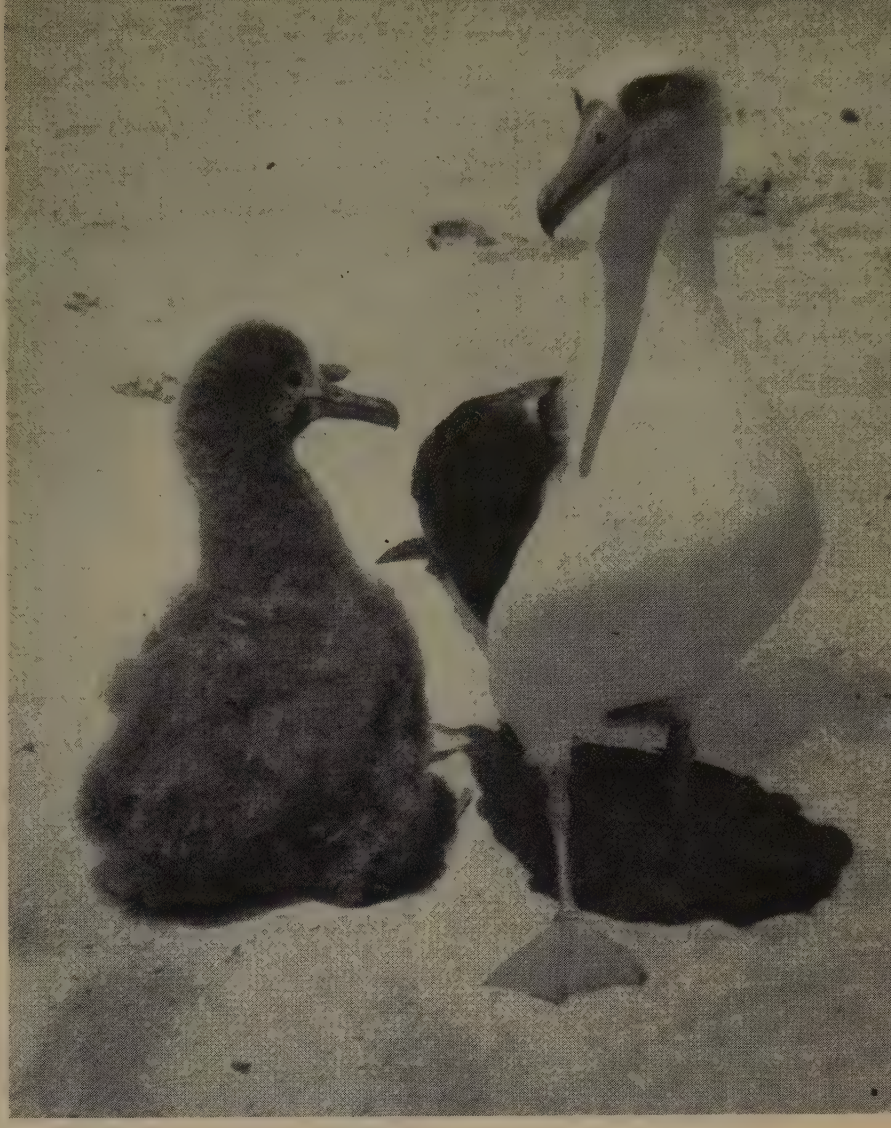
Although all young gooneys, as

Gooneys put on a foxtrot. This odd dance always includes the raising of heads and stretching of necks to the accompaniment of long drawn-out groans. Photo by Lorin T. Gill

well as the old ones, look exactly alike to a human being, the babies clearly recognize their parents and vice versa. After feeding the chick, the old birds rest a few minutes, perhaps imparting a little advice, and then return to the open sea for more food.

After the babies are a couple of months old they begin to stray from their respective nests and pick fights with one another. If the parents return and fail to find the young one in its nest they resolutely set out hunting for it. It is said that, upon locating their errant youngster, they proceed to give the chick a good thrashing by pecking at its head and back. The chastised baby seems to realize it is in the dog house, and as soon as it has half a chance will make a bee-line for its nest. Only when it has settled itself in it will its parents feed it.

Poor little tykes, they were always hungry. They would eat from our hands, gobbling down everything offered, even nibbling gently at our fingers. Best of all they liked sardines and canned salmon, but they would eat beefsteak, raw bacon, bread, in fact anything that came their way. We will hope there will never be a Congressional investigation of how many baby gooneys were surreptitiously supported out of the mess halls of the Marine camp and the construction camp.



Parent gooney and its youngster. One egg is laid each year and the nests vary from holes kicked in the sand to more elaborate affairs. The babies are most appealing.

Like many other wild creatures, the gooneys are heartless to members of the colony outside the family. Sometimes a baby's parents fail to come back. After waiting patiently and hungrily for a long, long while, he may venture to beg food from another of the old birds. Babies showing such temerity always get a sound beating but never any food. Such is the Law of the Clan. It is estimated that nearly five percent of the young birds die of starvation in July and August when they are nearly seven months of age.

In late summer, when the parent gooneys decide it is time to shove off for other pastures, they do so without formality. The young are left to shift for themselves, without food, and to learn to fly by trial and error. Fortunately, they have a heavy reserve of fat, the result of the feeding of the highly nutritious pre-digested fish that the parent birds have brought them. On this they must subsist, and build up their contour feathers.

This is usually in July or August. Summer showers are frequent, and with the showers come wind. When the storm starts, all the little gooneys stand up and face into the gale. They spread their wings and flap them violently up and down. As time goes on, and their muscles grow stronger, they hop up and down. Finally they take an experimental step forward into the wind. If a violent gust hits them, like an improperly-built kite they may swoop off the ground for a few uncertain feet, only to be thrown over backward and sent sprawling, to their sheepish-faced chagrin.

But they are tough and can take it. They have to take it, or there would not be any gooneys. By and by they learn to run over the sand quite rapidly, their wings widely spread and flapping with all their might. They take off and after attaining a dizzy elevation of ten or twelve feet, look down and get scared. They forget to flap, momentarily, and hit the ground—kerplunk!

It takes them about a month to learn to fly. Finally, one day in late summer, they put out to sea, headed for some mysterious realm known only to gooneys. Apparently they do not return to Midway. In July, 1937, ninety young gooneys were banded at Midway. None ever returned to the island, so far as known. Only one of the group was ever reported. He was taken aboard a Japanese fishing vessel 2000 miles

Sooty terns descend upon Midway to the accompaniment of screams and screeches, but some weeks will pass before they finally settle down to make nests and lay eggs. Black-footed albatrosses (upper, right) also come to Midway. Below, a young Laysan albatross, or gooney, and a sooty tern. The gooney is beginning to get its new plumage and is already on its own.

northeast of Midway on December 12 of that year.

By mid-August all of the old gooneys, as well as most of the young ones, have left the island. Only a few sick ones and the physically disabled remain on the beach. During their first efforts at flying many drown in the lagoon and are eaten by sharks.

Midway is also home to a number of other noteworthy sea fowl, but none so thoroughly beloved as the gooney. There are the black-footed albatross, the wedge-tailed shearwater, called locally the "moaning bird"; the white or love terns, *Gygis*, and the sooty terns.

At certain times of the year there were so many sooty terns on the island that a man scarcely dared breathe for fear of sucking one of them down his windpipe. Well, almost that many. The first flock of the season appears some pleasant evening in March or April, usually about sundown. Long before the sharpest eye may distinguish them in the offing, their cries fill the air, growing in volume as they approach. All night long they circle and screech over the island, flying in great whirlwind-like formations, but never alighting.

Early the next morning they go out to sea, fishing. By sundown they are back and another night of bedlam begins. This goes on for five or six weeks. After the preliminary warning of a month and a half, they really settle down to making life hideous, and, instead of merely screaming over the island at night, they scream both day and night.

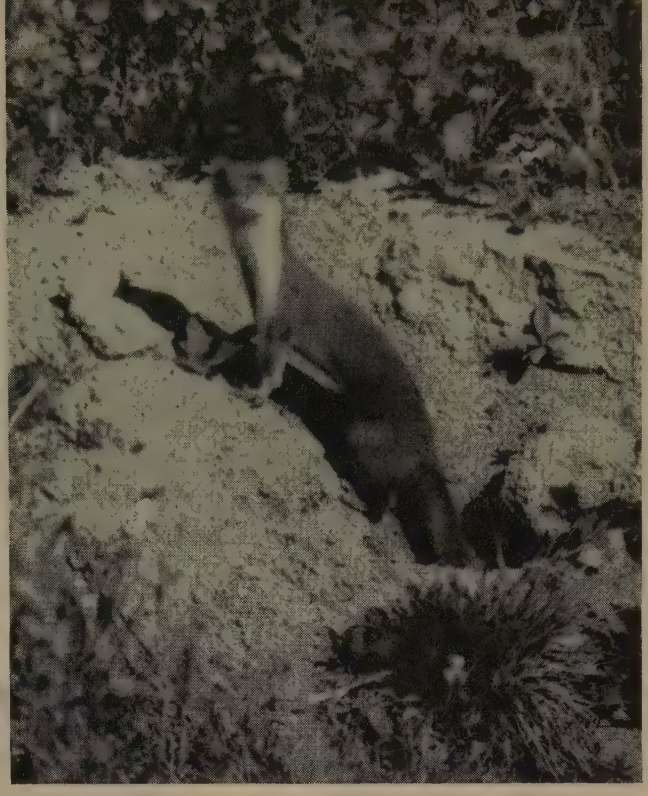
It is nearly two months after their initial appearance before they start alighting on the ground, at first for only a few moments at a time. Gradually they lengthen this time, finally making their nests and laying their eggs. But the incessant screaming never stops.

The wedge-tailed shearwater is an eerie, ghostly creature the size of a pigeon with a gray back and white breast. They fly only at night and live in holes in the ground. We were forever breaking through the shallow ceilings of these underground caverns and plunging up to our knees in moaning-bird bedrooms.

In beginning her eastward and southward campaign, Tokyo promised to liberate all the "oppressed" natives of the Pacific Islands.

These—the gooney birds, the sooty terns, the moaning birds and their feathered neighbors—are the only natives of Midway. No one who had ever lived through a nesting season on the island would say that they had fared too badly under the protection of the American soldiers and civilians on Midway Island.

The old Richardson's ground squirrel announces the presence of a weasel in the colony. All others were underground while this one stayed on the surface, warning with an occasional sad whistle.



The long-tailed weasel emerges from the burrow of a ground squirrel. While the weasel can dig if it must, it usually takes over the squirrel habitations and takes advantage of the several exits they have.

Among the most graceful and courageous of our smaller animals we find—

The Long-Tailed Weasel

Photographs copyright by the Author

By H. H. PITTMAN

WEASELS are among the most graceful and courageous of our small animals, and go through life with an independence and singleness of purpose that is really admirable. Although to some of us they may be rarities, they are widely distributed and, in places, common. Just how numerous they are is often difficult to determine as they wander freely and we have no means of telling how frequently we may meet the same animal.

In southern Saskatchewan, Canada, the common species is the large long-tailed weasel, *Mustela longicauda*, a beautiful reddish-brown animal with a pale yellow throat, neck and undersurface. On the open prairie its principal food consists of ground-squirrels, but it preys just as readily upon hares, game birds or domestic poultry, when opportunity permits, attacking birds or mammals many times its own size and weight. While deploring the destruction of poultry we must admit that its effect upon the ground-squirrel population is of great importance, particularly in cultivated districts. As it can climb well, the eggs and young of small birds probably form a substantial part of its diet in early summer.

The attitude of the long-tailed weasel toward man is interesting and seems partly one of toleration. If you keep still he will inspect you from a short distance and then continue on his way. If he happens to be hunting he may pass right beside you, even over your feet, engrossed in his occupation, especially if the quarry is close. If you chance to meet one on a prairie trail he sometimes gives ground rather grudgingly, although without fear, and may even make a caustic remark as you pass. He is, however, insatiably inquisitive when not alarmed, and may come from a considerable distance merely to look at an intruder, standing erect for a better view. He will let you follow if you do not crowd him, and will almost play with you for a time while his curiosity lasts, but the moment his interest flags he disappears.

Normally the weasel is a restless, energetic animal and rarely remains long in any place. It may stay for a week in the neighborhood of a farmyard or granary where food is abundant and then may not be seen again. Naturally there are many exceptions. The C.P.R. agent at Wauchope, Saskatchewan, had a

A young long-tailed weasel of the Canadian prairie country. This lithe little animal, more beneficial than usually believed, is about half grown. Below, a weasel gazes curiously from the entrance to a burrow, alert amid the surrounding grasses.

gentleman's agreement with one that he allowed to live under the station platform as long as it killed rats in the adjoining grain elevators. Unfortunately a stray dog ended the contract before the winter was over. I knew of another that lived under a granary for months, preying on mice and rats in the vicinity.

Although apparently foot-loose, I believe our large weasels have fairly well-defined ranges, frequenting one part or another according to the local food supply in any particular area. The seasons and, of course, the weather might have some bearing upon this. Wherever I have met with a hunting weasel I normally expect to see one again, sooner or later. Admittedly this proves nothing, for the trails attracting one weasel may naturally attract another, but it has happened so often that I am led to believe that they live in or have more or less definite hunting grounds.

In this district young weasels are born about the first week in May, and may be as many as nine in number. The nest is generally in a deserted or usurped ground-squirrel den. Weasels can dig, but I have not seen a burrow that they appeared to have excavated for themselves. Strangely enough, convenience rather than concealment seems to be their watchword, and the nesting-holes used are sometimes right out in the open. However, the long-tailed weasel changes its home readily, and a den found occupied in the morning may be empty by afternoon. The young ones are carried, one at a time, by the loose skin on the back of the neck, which, in the smaller weasels, seems especially adapted for this purpose.

Not long ago I noticed the head and neck of a long-tailed weasel at the entrance of a Richardson's ground-squirrel's burrow on the prairie, alternately stretched out snake-like over the grass and then almost at ground level as the animal excitedly raised and lowered its head to study me. Running across, I placed a large stone over the opening and then hurried away to the tent for a camera and tripod, believing I had a wonderful opportunity to get some pictures. After I had waited more than an hour a dying ground-squirrel staggered out of another hole, dropping almost literally at my feet, and I realized the burrow I was watching must have another exit. Shortly afterwards I saw the weasel on the surface some distance away and decided to follow, although I had only a heavy stand camera with me.

Eventually I managed to edge the weasel away from the warren to where the holes were widely scattered and finally found one that apparently held some attraction for him. After a little delay he made several efforts to leave the hole, and I had to keep driving him back while I tried to set the camera up and adjust the focus. As he became accustomed to my shouting I had to increase my demonstrations

until at last I was wildly waving a handkerchief and throwing my hat in the air to hold his attention. After I had made two exposures the animal disappeared; then suddenly was looking out of a hole about twenty-five yards away. Dropping a handkerchief over the one in front of me I ran across and placed a heavy stone on the second hole. Although he could partly lift it, he could not get out.

All this time an old Richardson's ground-squirrel had been sitting upright on a mound mournfully whistling a warning to the squirrel colony. Suddenly it darted down and savagely attacked the weasel, as it tried to leave another hole, and drove it back under ground. This occurred several times before the weasel gave up. Soon I had four holes covered and one guarded by the ground-squirrel, so returned to the camera expecting to get some pictures. Just then I saw the lithe animal come out of still another hole and return to the warren. While it was aggravating, this experience was most interesting for it showed that this apparently isolated ground-squirrel den had at least six exits, most of them well concealed in the grass.

The next logical move seemed to be to photograph the courageous little ground-squirrel, still sitting up and pathetically announcing the presence of danger. After packing up I met the weasel again, and by patient following and the accompaniment of every attention-holding noise and movement that I could think of, succeeded in getting a full length picture of him. His behavior suggested that of all violent lunatics he had ever met I was the worst. He retained his dignity but I felt chastened when we parted.

The long-tailed weasel turns white with the approach of winter, and skins taken at this time are the ermine of furriers. The change of color starts on the lower surface of the body, and the last parts to become white are generally the middle line of the back and the top of the head, both places, it should be noted, where there is little flesh or fat. When the snow is late in coming the white weasel is most conspicuous, but as he travels and hunts as freely by night as by day he does not suffer much inconvenience.

It is impossible to have anything to do with the weasel, even if only through the casual contacts of the prairie, without realizing that it is unusually intelligent. In captivity, with the stimulus of hot blood and excitement removed, it could possibly be tamed—at least to the extent that ferrets are. Ferrets are closely related carnivores yet sometimes make most affectionate pets. My aunt would occasionally place some ferrets on a table and then go and sit across the room. When she called, each animal, in turn, would jump over into her lap. The long-tailed weasel seems naturally playful and adaptable and is probably much more beneficial than is generally believed. In England a similar species is called the stoat, a word derived from the old English "stot" meaning stout, or, as we would say today, bold. Long-tailed weasel is a "stout fellow."

★

To a Tufted Titmouse

(Upon his successful extraction of a caterpillar from its cocoon.)

By J. CHARLES TRACY

Well done, small friend! What bird
Has better right to perch and preen?
You wink, and fluff your plumes
And tell me all. But you were seen!

I heard your joyful call
And watched you through the hemlock green,
In search of morsels where
A nuthatch had already been.

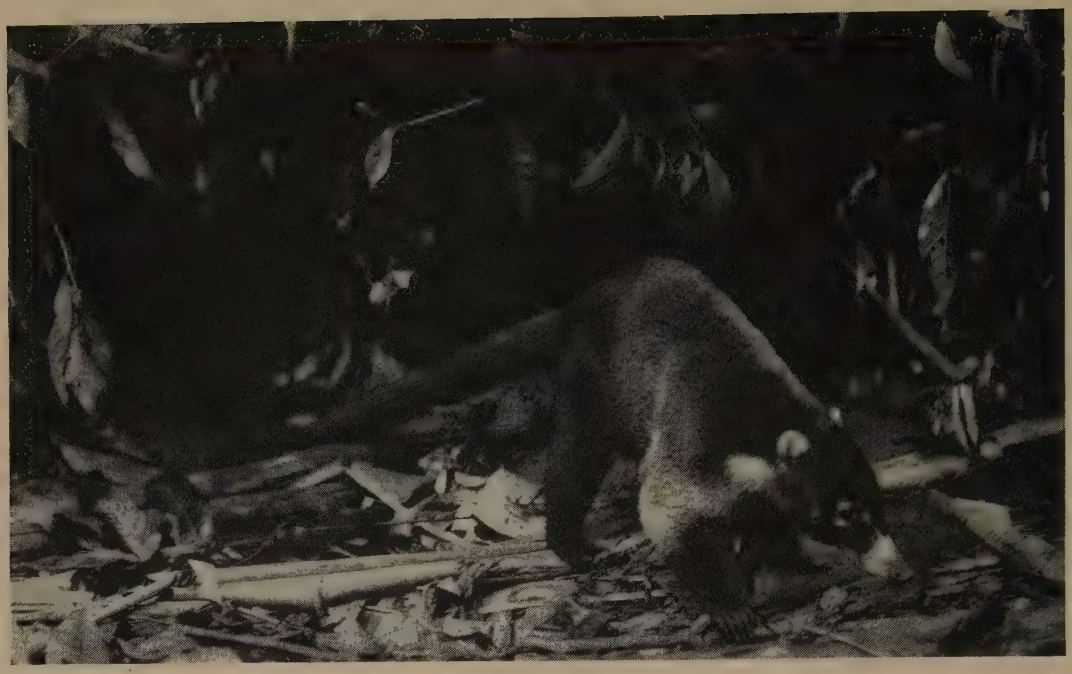
What's this, you cried, a meal?
This leafy lump, unsightly brown—
A trick, you thought. No worm
Would hide in there. *I* saw you frown.

But wait—'twas worth a try
Some gnat or midge might be inside.
You cocked your crested crown,
And tried so hard to save your pride.

Your patience, now! I watched
You kick it with your claw, my clown—
Can'st tell me what was gained
By hanging from it, upside down?

There—leaf by leaf is how
To find the unsuspecting prey
Make haste! Or sleeping lunch
Might turn to moth and fly away.

Look what I've found! You gulped
The embryonic Luna queen
And nearly choked. I know—
You think you're smart. But you were seen!



Coatis "were deployed over the forest floor, foraging for roots, insects and larger game." ←

→ "The stately frigate bird . . . obtains a great part of its food by piratical method."

Teamwork in Nature

By IVAN T. SANDERSON

IT IS ONE of the oddest aspects of Nature that animals that are marked individualists may, on occasion, display teamwork astonishingly similar to that of human beings.

I have seen a hungry monkey in the jungle forego food until it had called its fellows to share in some fruit that it had discovered, and have watched a fish wriggle over a mudbank, to show its companions the way to safety. Lions hunt with their mates, one lying in wait while the other scares up the game; sea birds aid their own kind to rob other birds of fish; certain insects labor together to accomplish tasks that benefit any one of them only by benefitting all.

Animals' deliberate teamwork on occasion seems to require not only forethought, but, also, the transference of ideas by speech or by extra-sensory perception. Sometimes their actions even appear to be prompted by motives that we term ethical.

Who would expect such brutish animals as crocodiles to work together for a common purpose? Yet I often observed deliberate cooperation between these animals in a jungle river in Nicaragua. We wanted several crocodiles but they were scarce, and in order to attract them we tied the flesh of giant river clams with wire to tree roots by the water's edge. After dark we came back to make our captures. Sometimes we found no bait and no crocodiles; sometimes there were several crocodiles worrying the clam, but there was never a lone crocodile at a bait.

We watched to find out why, and saw one approach, snap at the bait, and try to dive back with it into deep water. When the wire attached to the root brought him up sharp, he tugged for a few seconds and then disgorged the bait. After several such attempts he gave up and disappeared into the depths. A few minutes later he came back with a companion and *together* they tugged until their combined strength snapped the wire.

We tried stronger wire, but each time the crocodile scout brought back with him more aides. And he invariably brought back just the right number to do the job; he never made a second trip for extra help.

Reptiles' brain capacity is small, yet they seem capable of intelligent and premeditated acts of coöperation. This was brought home to us in the West Indian island of Jamaica by two little lizards. Some condensed milk had been spilled on a sawed-off tree stump outside our window, and the sweet liquid attracted butterflies. The local lizards, with their sharp little black eyes, soon noted this. A large lizard took up his station just below the rim of the stump, and when a butterfly alighted on the patch of gummy matter and began to feed, the lizard painstakingly stalked the insect by a roundabout route. When he thought he was close enough he made a dash, but the butterfly was too quick for him and flitted away. The lizard returned to his post and presently the greedy insect was back. Again the reptile stalked it, and again it was unsuccessful.

This happened four times. Then the lizard, instead of returning to his post, ran down the stump and hopped on a stone wall, trotting along looking

from side to side until he spotted another of his kind. Then he stopped, raised his head, blew out his yellow throat-pouch and went through a series of nods and bows. This done, he wheeled about and went straight back to his post on the stump. The other lizard followed him and went directly to the other side of the stump. Both hid just below the rim.

Now began a brilliantly coördinated strategic advance upon the butterfly. The newcomer crept around below the rim, taking occasional cautious peeks to see how his friend was progressing, until he himself was just below the quarry. Meanwhile the first hunter made his usual approach, ending in the swift rush. The butterfly, as before, flitted away from his attacker, only to be snapped up by the second lizard. The two lizards successfully teamed up in this way time after time, until the sweet bait had dried out and butterflies no longer came to it.

I once met a large troop of coatis—those long-nosed, raccoonlike animals so common in zoos—in the jungles of South America. They were deployed over the forest floor, foraging for roots, insects and larger game. Concealing myself, I sat down to watch.

A large male gradually worked his way toward me and discovered the entrance to an armadillo's hole. He sniffed at it, backed out hurriedly and began looking excitedly around. Presently he found another hole, for armadillos always make two entrances to their burrows. But instead of going in, he rushed, grunting and whistling, to the rest of the troop. Two of his companions came back with him. The discoverer stationed one of his pals at the first hole and then trundled off directly to the other entrance, followed by the third animal. When the latter had taken his post there, the leader went into the hole.

In a few minutes pandemonium broke loose down below and an armadillo shot out of the hole. The watcher above immediately leaped on the terrified beast. Then the coati stationed at the other hole dived below.

We intervened at this stage, stopped up both of the holes, and started to dig. When we reached the armadillo's nest we found the two coatis, the mother armadillo, and the remains of several of her young. Had it not been for our interference, three coatis, by their wily coöperation, could have captured the whole family of armadillos.

After such evidence of teamwork among wild animals, I kept my eyes open for further instances, and soon discovered that the practice is far from exceptional.

A camp of ours on the bank of a large river in South America turned out to be directly under a monkey highway. Little green squirrel monkeys came by, every few days, on their perpetual travels in search of ripening fruit.

One day, while I was watching a troop of them in a tree, I saw an individual wander off from his companions and work his way into an isolated palm tree. Here he found some fruit, which he tasted. Apparently it was just right for he jumped up and down and made appropriate noises, but the rest of the troop were now out of earshot.

Instead of immediately gorging himself in the selfish manner we consider so typical of the monkeys, the little chap returned to the troop, found a friend and came back with him in about half an hour. Arrived at the palm, the second monkey, which was much larger and older than the first, also sampled the fruit. He too jumped up and down, chattered happily, and went back to the troop. Shortly, with a great hullabaloo, the entire troop came, following him to the tree, where all partook of the feast. We surmised that the big fellow was a leader who had to see the fruit for himself before he would order the troop to come and get it, showing solicitude for his kind.

In many ways rodents surpass all other animals in general intelligence, and it is perhaps among them that we encounter the most frequent cases of deliberate coöperation.

We once had as pets two large tree-rats of a rare species. We found them so sagacious that we tried upon them some of the famous experiments that scientists have made upon tame rats in order to measure the animals' intelligence. One trial was to give the rodents large biscuits that could be drawn into the cage only by upending them. The rats were in a cage whose front consisted of vertical bars about three quarters of an inch apart. The tough dog biscuits were square ones about four inches across and more than half an inch thick.

Our rats figured out in record time how to get two of these into the cage, but the third biscuit we gave them was exceptionally large and heavy and neither of the rats alone could up-end it. There came the most remarkably skillful demonstration of animal teamwork that I have witnessed. One rat put his head through the bars, seized the edge of the biscuit with his teeth and raised it a little. The other slipped his nose underneath it. Next, by a series of careful maneuvers, like a couple of furniture movers getting a valuable piece of furniture through a narrow door, the two rats got the heavy biscuit up-ended and with an edge facing the bars. Then, together, they pulled it in.

In West Africa there is a curious-looking animal with plumed ears known as the Red River hog. On one occasion we saw the leader of a drove of these hogs approach a large log lying in a swamp. He sniffed underneath it, then trotted round to the other side of it and sniffed again. He knew there was something tasty underneath, but apparently realized the log was too big to move. So he called the rest of the drove.

The hogs arranged themselves in a row, shoulder to shoulder, along one side of the log. Plunging their sharp snouts into the mud, all heaved until the log rolled over. As it did so, there was a scramble for the succulent giant snails that their combined efforts had yielded.

Gregarious animals such as pigs often rely on teamwork in hunting or to protect themselves from foes. Wild hunting dogs of Africa pursue small antelopes in relays, tired members of the pack dropping behind while fresh contingents take up the chase. When a herd of muskox is attacked by wolves, the males form a ring, shoulder to shoulder, all their heads facing outward and lowered so that a wall of bristling horns is presented to the attackers. The females and young are placed inside the ring.

The stately frigate bird or man-of-war, reputed to be the best flier of all living creatures, obtains a great part of his food by piratical methods. A ruthless hijacker of the air, he robs industrious fisher-folk such as the booby bird. Once, off the Gulf Coast, a number were seen gliding and wheeling high over the water, while the hard-working boobies were fishing far below.

When a booby had loaded himself with fish, he set out for home. Then a man-of-war would swoop. The two would wheel and soar and dive, the booby intent upon saving his meal, the frigate bent upon making him give it up. Usually the other men-of-war continued to sail majestically round, aloof to the whole affair, but occasionally, when the booby was particularly crafty and stubborn, his pursuer called in a friend, and the two teamed up in the chase.

One pirate dived from above while another swooped up from below. They never touched their victim, but swirled past him within inches, uttering fearsome cries. The poor booby's aim was to get down to the crests of the waves, the frigates', to keep him aloft, and the two frigate birds worked together with perfect coördination. At last the poor booby decided he had enough, and spewed up his fish. In a flash a frigate swooped and caught it before it fell into the sea below.

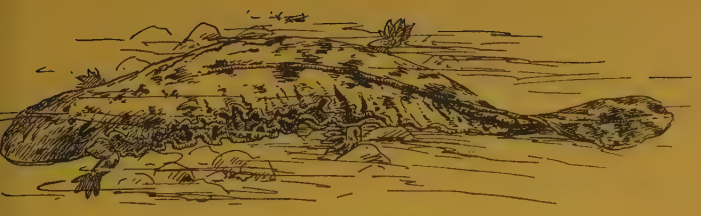
Young frigates are black and white, while adult males are entirely black. On occasions when so distinctively marked individuals teamed up, I could easily differentiate between them, and in every such case it was the original attacker who claimed the trophy. The accomplice, who had been called in to assist, simply soared away, even when he was nearer to the falling fish.

My father, who spent much time watching wild animals on his farm in East Africa, used to relate to me vivid accounts of the methods used by lions in capturing game.

At sundown the male lions would roar loudly so that all the game might know where they were. Then the lionesses would slink off silently and conceal themselves by the game trails leading from the water holes. Meantime the males would circle far around and approach the water holes from the other side, still heralding their coming with veldt-shaking roars. The thirsty game would hurriedly drink and then bolt away in the opposite direction, following the trails straight into the jaws of the lionesses. After the lionesses had had time to make the kill, the males would cease their thunder and hurry straight to the evening meal.

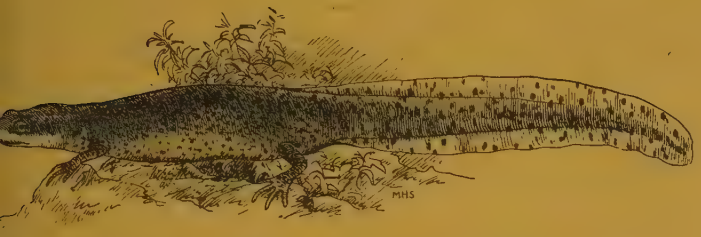
It is not only hunger that prompts animals to cooperate. Only impulses—even compassion—may call forth teamwork. Naturalists have recorded instances of two elephants' supporting, between them, an injured member of the herd and thus aiding it to escape from the hunter. In fact, elephants appear to be the most compassionate of all wild creatures.

A man who had spent half a lifetime in the jungles of Bengal and Burma once told me of a remarkable case he had witnessed. A successful hunt had resulted in the capture of a full-grown cow elephant and a half-grown bull calf. The (Continued on page 333)

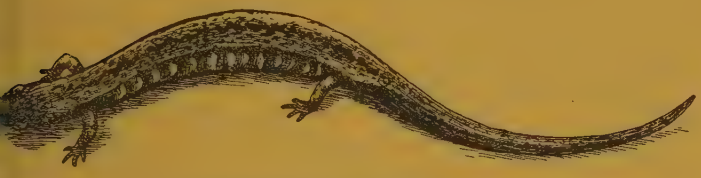


HELLBENDER

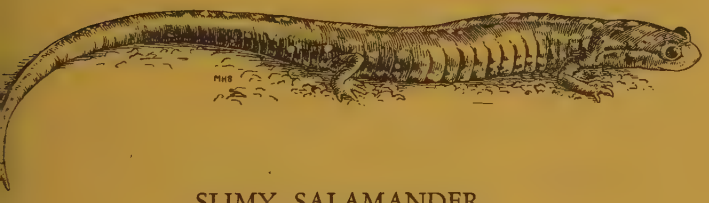
MUD PUPPY



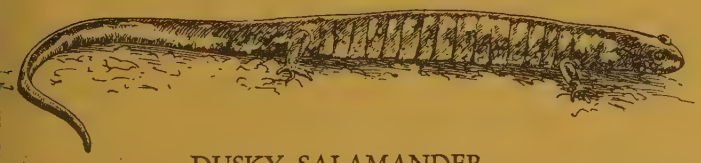
VERMILION-SPOTTED NEWT. RED EFT



TWO-LINED SALAMANDER



SLIMY SALAMANDER



DUSKY SALAMANDER

SPOTTED SALAMANDER

This is the thirtieth in Nature Magazine's series of educational inserts

Some Common Amphibians

By E. LAURENCE PALMER

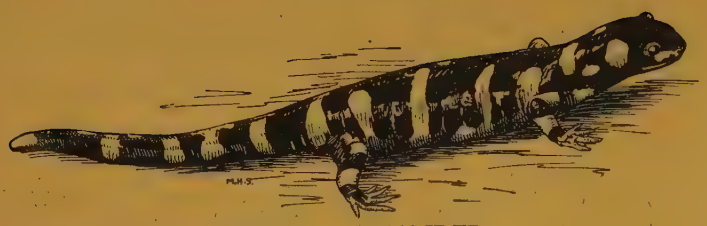
Illustrated by M. Hope Sawyer

IN THESE days of amphibious warfare, it is appropriate that we gain some understanding and appreciation of the worth of the group of animals that are, because of the amphibious nature of most of them, called the amphibia. Many of us have been conditioned adversely against these animals. Possibly this dates from the day we read of them in Sunday School, in Exodus. There, we were told that they were classed with lice and flies as plagues upon the earth. Some of us who had spent many days of the week hunting frogs for their legs, with a bit of flannel tied to a hook, wished we could have witnessed the Egyptian magicians turning dust into lice and could have been present when "the river shall bring forth frogs abundantly, which shall go up and come into thine house, and into thy bedchamber, and upon thy bed, and into the house of thy servants, and upon thy people, and into thy ovens and into thy kneading troughs." However, after eleven similar verses, ending in the statement that "the land stank" when the frogs were destroyed, most of us had a well-established aversion toward frogs.

Then, after we had been well convinced that these animals were to be despised, we stumbled on Shakespeare in *As You Like It,* telling us,

> "Sweet are the uses of adversity,
> Which like the toad, ugly and venomous,
> Wears yet a precious jewel in his head."

To be sure, the toad is not exactly a frog. And, to be sure, it is not complimentary to be considered ugly and venomous when you are not. Still, there was something fine about the critter, or it would not bear a precious jewel in his head. Or, was the jewel-in-the-head idea a bit off color? I know that in my own case I wondered for years about the jewel in the head, and although I had pulled frogs to pieces in high school and college laboratories after taking them out of formalin, I still could see nothing in them that was really intriguing. Then one day when I was about twenty I had occasion to watch a live frog closely as he sat on a log under which was a trout that I wanted. I never got the trout, but then and there I discovered that



TIGER SALAMANDER

the live frog had not one but two jewels in his head—namely his eyes. About the same time I got acquainted with a college professor who was a crank on frogs—live frogs, not dead ones. He took me on a peeper hunt. There, I saw for the first time a peeper making the sounds I had enjoyed for years each spring. He showed me how to find frogs, not in the marshes, but up in trees. He had me watching their love life without a blush, identifying them even in the tadpole stage and genuinely considering the advisability of abandoning weed seeds and fishes and whirligig beetles in favor of making the study of frogs my life's work. Fortunately, I abandoned all of these specialities for a more general interest, but I never really got over my enthusiasm for living frogs. Since that time, I have always awaited each season for the sequence of frog sounds and for the date when I first could find the eggs of some frog or related salamander.

Not one of us would ever want to miss the thrill of seeing Shakespeare's witches in *Macbeth* brewing their venomous stew. Add to that famous mixture, which is fed to all high school students in their English classes, the experience of dissecting a formalin-soaked carcass in a biology laboratory and what do you have?—certainly, not a true appreciation of a frog or of a newt. The eye of a newt staring at you from the depths of the witches' pot cannot match, negatively, the positive thrill one gets from seeing many little red efts or newts prowling some early wet morning through the leaves and undergrowth of a favorite woodland. Shakespeare's *Macbeth* has probably not intrigued many to wish to know more about the amphibia. He went out of his way in the witches scene to malign them and to attribute to them qualities they do not possess. While this is fundamentally dishonest and unfair to the amphibia, I am sure that none of us would want to delete this gem from his writings, any more than most of us would vote to outlaw Santa Claus.

TREE FROG

SPRING PEEPER

CRICKET FROG

COMMON TOAD

What Are the Amphibia?

A college graduate who had had work in biology once stood beside a beaver dam with me and remarked: "Beavers live on land and water, don't they? Therefore, they must be amphibia. Therefore, they must have gills and must lay eggs. Where does a beaver lay its eggs?" Of course, he had not made an adequate distinction between amphibious and amphibia. The beaver is amphibious but not an amphibian. The amphibia are a group of cold-blooded animals placed in the evolutionary scale by zoologists between the fishes and the reptiles. For the most part, they have smooth, moist, or slimy skins, without scales, and for the most part they lay their eggs in water or in moist places. There are three main groups of living amphibia, of which one, the Apoda, are legless and wormlike, and tropical or subtropical in range. The other two are represented in this discussion; one, the tailed amphibia or Caudata, includes the mud-puppies, sirens and salamanders; and the other, the usually tailless amphibia or Salientia, includes the frogs and toads. For the most part, they must live in a moist or wet environment, and for this reason the commonest places on land to find many of them are in the moist microclimates to be found under stones and logs, usually in damp woods. There are at least 2000 living species of amphibia, of which about 200 are in the salamander group, and about 1740 in the frog-toad group. There are probably more species and individuals of the amphibia to be found in the United States than in most similar areas in the world. There are 126 species and subspecies of salamanders in the United States, Canada and lower California.

The Salamanders

In body form, many of the salamanders resemble some of the lizards, which are reptiles. It is not surprising, then, that to many people they are "lizards." Even John Burroughs in one of his writings describes them as being

reptilian, although he does not do this with any attempt at disparagement. Most salamanders avoid the light and are therefore commonly nocturnal in their habits. In the breeding or migration seasons, however, many that normally avoid light may be found in it. While the chief food of salamanders is small living animals, some of them will feed on carrion and others will eat plants. While some can withstand a freezing temperature, most of them avoid the severe weather of winter by burrowing into the warmer parts of their environment. Similarly, in the dry summer months, they may burrow into the moister, cooler parts of their surroundings. The salamanders lack the vocal cords found in the frogs and toads. The few sounds some of them utter have not been satisfactorily explained.

Not a few salamanders excrete slimy material that is obviously distasteful to their enemies. This material may also serve to prevent undue drying of the animal when it is living in dry air. The flesh is probably not poisonous, but the animals have been known to serve as reservoirs that in a period of 122 days excreted enough colon bacteria dangerously to contaminate 237 gallons of water a day. Both purple and dusky salamanders have been known to do this. Undoubtedly, such animals had eaten insects that had fed on contaminated wastes of mammals. Because of this, these animals should not be tolerated in springs supplying drinking water in the vicinity of human settlements.

On the other hand, salamanders are known to be efficient destroyers of the larvae of mosquitoes that may carry disease, and so salamanders, like the newts that can go overland from one small temporary pool to another, may contribute to the healthful conditions of an area. Put a newt in an aquarium with mosquito wrigglers if you wish to see a demonstration of what happens here. An adult newt in an aquarium with a mass of hatching frog eggs will also show you conclusively how these animals may be in part responsible for the small number of adults that may develop from the great masses of eggs to be seen. I have seen a newt at rest on a mass of these eggs picking off the little tadpoles almost as quickly as they freed themselves from their protective egg jelly. In a fish hatchery, a newt may be a real pest as it eats young fish and fish eggs.

RED-BACKED SALAMANDER

PICKEREL FROG

GREEN FROG

MEADOW FROG

WOOD FROG

BULL FROG

The life history of the salamanders is highly varied and invariably interesting. In some, like the red-backed salamander, and some of the salamanders found in trees in the West, the larval stage is spent in the eggs, which are often kept moist by the mother, who may remain coiled about them. In others, like the hellbender, the egg mass is protected by the male, who eats a few before he fertilizes them, and who apparently does not again get hungry until his young have departed in safety from the mass he protects.

The courtship of many salamanders is most amusing to watch, and the actual fertilization of the eggs may be so different from what happens in most other animals as to be almost unique. Where a breeding migration takes place, the males usually precede the females to the breeding ground. There the males of some species may put on a sort of dance, or in some cases may engage in an elaborate series of caresses of the female. Following this, the male may deposit on the bottom of the pool a gelatinous cone or spermatophore on the top of which are the sperms. If the female has been sufficiently stimulated, she settles down on this and takes the sperms into her body where they fertilize the eggs. In other salamanders, including the mud puppy, the eggs are fertilized externally when the parents free the sperms and eggs into the water at about the same time.

It is not possible here to relate much of the details regarding the development of the stages following fertilization. In most of them, the larval stage is spent in the water, the animals breathing by gills, which appear as fringes in the throat region. In the mud puppy, the whole life history is spent in the water. In the dusky salamander, the egg may be laid on land, the young larvae living at first at the water's (Continued on page 312)

COMMON NAME SCIENTIFIC NAME	HELLBENDER *Cryptobranchus alleganiensis*	MUD PUPPY WATER DOG *Necturus maculosus*	VERMILION-SPOTTED NEWT. RED EFT *Triturus viridescens*	TWO-LINED SALAMANDER *Eurycea bislineata*
DESCRIPTION	Length: to 2 feet. Head: broad and greatly flattened. Legs and feet: larger than in the Mud Puppy, but useful primarily in the water. Skin, looks as though it were greatly wrinkled, and much too large for the animal. External gills such as are found on the Mud Puppy, are absent. Gills are internal. Dark-brown to black.	Length: to 2 feet; may mature at 8 inches. Tail: flattened, powerful. Legs: 4, weak. Feet: 4-toed. Head: short, but with fairly pointed nose. Behind head on either side, are 3 tufts of fluffy-looking, reddish gills. Dark-brown or grayish-brown or black, usually with spots or mottlings, darker. Skin: slimy and difficult to cling to.	Average length: 3 to 4 inches. Adult: brown, with red and black spots. Tail: fin-like, most conspicuous in male. Male: with black swellings on thighs and feet; lacks foldings conspicuous near vent of female. Red land form is immature, lacks fin on tail, is red all over except for fine spots, and has rougher skin than adult.	Length: to 4 inches. Tongue: free at front margin, but attached at the center, beneath. No line from eye to the nostril as in Purple Salamander. Pale straw color, with a narrow, dark line on each side running from eye onto the tail. Belly: yellow. Sides: dotted. Tail: flattened, thus differing from the Dusky Salamander.
RELATIONSHIPS AND RANGE	Two genera of Giant Salamanders, *Megalobatrachus*, of China and Japan, and *Cryptobranchus* found in rivers and lakes in eastern United States, particularly in the Lake Erie, Ohio valley region and the rivers that flow from the Allegheny highlands, south to Louisiana and Georgia.	In rivers or quiet freshwater, usually at depths of 4 to 8 feet, and commonly among water plants. Commonest in eastern United States, north and west of Alleghanies, particularly in Great Lakes, Mississippi and Hudson river systems and south to Georgia and Alabama. Two species and a related *Proteus* of Austrian caves.	Genus includes: Giant Newt, *N. torosus*, of humid California, Oregon and Washington, and Common Newt, *N. viridescens*, of eastern North America from Hudson Bay to Texas, west to western Illinois, Michigan, Missouri and Oklahoma. Found in fresh water or on land through the year.	Range: from northern New England to Florida and west through southern Canada to Lake Superior and south to Louisiana. Found almost exclusively at water's edge, in cool streams, under stones and logs, usually in shallow water. Nine related species within essentially the same range.
REPRODUCTION	Male courts female as she lays a tangled string of some 400 eggs, under a rock in August or September. Male adds milt and eats a few eggs and then protects them by curling around them. In 10 weeks, before he gets hungry again, eggs produce young much like the parents. Male really protects food, not young.	Eggs: about 66, each with 3 jelly coats and attached by gelatinous stalk to underside of stone or log or, in sand nest, in about 4 feet of sunlit water; hatch into .75-inch larvae which resemble parents, and by 10 weeks reach length of 1.4 inches. Yolk sac: still attached sometimes until larvae 1.5 inch long, then absorbed.	After courtship embrace, male deposits mucus sperm holder. On this, female settles; then lays to 90, .06-inch eggs, singly on water plants. Eggs hatch to gilled larvae. These, in 3 months, are one inch long, then lose gills and leave water as red land form which may develop 2 years before adult water form is assumed.	Eggs: laid singly but near each other, under submerged rock, April to August, diameter, .2-inch; with 3 jelly coats; to 68 per female, hatch into .5-inch honey-yellow, slender larvae which in 2 years reach 2-inch length and transformation into adulthood, when gills are lost.
FOOD	Food: mostly crayfish, insects, worms and other aquatic animals found usually at night when the Hellbender prowls about over the stony bottom of waterway. Fishes, turtles, and other large water animals eat Hellbenders readily and they are sometimes used as bait. Related Giant Salamander, Megalobatrachus, known to live at least 52 years.	Food: includes fish eggs, crayfish, worms, insect larvae, and other aquatic animals captured by prowling about the bottom. Movements may be slow but bite may be vigorous. Usually, remains hidden during day, begins to roam when darkness approaches. May be active throughout year. Slime protects from enemies.	Food: almost any small aquatic animal captured by slow approach and sudden snap of jaws. May hunt mass of hatching frog eggs and snap up young tadpoles as they hatch. May also destroy great numbers of mosquito wrigglers, young fishes, and similar life. May assume adult form in fall or spring.	Food: small aquatic animals such as insects, worms, crustacea, spiders and millipedes, caught by foraging in daylight more commonly than is customary with most salamanders. The slender shape, yellow belly, active nature, and two dark lines should be ample for identification.
ECONOMIC IMPORTANCE	Flesh: good for food for man, but rarely eaten because of animal's disgusting appearance. Not poisonous in any way, to man. Japanese eat and enjoy the Giant Salamander, which reaches a length of 5 feet, and its eggs, which are grape size. There are fossils of Giant Salamanders that roamed the earth 250,000,000 years ago.	Reported to be good to eat. Generally, recognized as enemy of fish nests and feared by some as being poisonous. Slime is probably distasteful to many enemies. Useful as specimens to students of animal anatomy, and therefore has a sale value to biological supply houses, one firm buying 2,000 or more in year.	Eft, land form, believed once to have mysterious qualities of fairies and pyxies. More realistic as mosquito, frog and fish enemies. In aquarium, may be fed ground beef on tooth-pick or from a dangling thread but will quickly depopulate aquaria of smaller forms of animals. Blood of some bears microscopic trypanosomes.	May serve as a check on some small animals of its environment and may also serve as food for larger creatures of the same regions. May have same relation to disease as discussed for Dusky Salamander but this has not been demonstrated and need not be implied necessarily.

SLIMY SALAMANDER *Plethodon glutinosus*	DUSKY SALAMANDER *Desmognathus fuscus*	RED-BACKED SALAMANDER *Plethodon cinereus*	TIGER SALAMANDER *Ambystoma tigrinum*	SPOTTED SALAMANDER *Ambystoma maculatum*
Length: to 7.25 inches. Smooth, slender, shining, dark, violet-black, to gray at the tail, with gray beneath; sometimes with pin-point, ivory white spots at the front of the body. Feet: pale brown. Front feet: 4 toed; hind, 5; all without large glands beneath. Skin exudes milky mucus at touch.	Length: to 4 inches. With a light line running from the eye to the mouth and the tongue attached at its forward margin. Larvae: with glistening white gills. Teeth: not confined to front of the jaw. Dark brown, usually uniform, but sometimes mottled with black-edged blotches, or with a broad black-edged back band.	Length: to 3.5 inches. With 19 vertical grooves on sides between front and hind legs. Color: highly variable. Some, all red or wholly dark. Usually, with broad back stripe of reddish, bordered by light brown stripe and "salt and pepper" sides. Others with "red" stripe, lead colored, these being called Lead-backed Salamanders.	Length: to 10 inches. Rather stout. Tail: 1.25 times the body length. Body surface: all rounded and convex, but with 13 vertical grooves on sides. Head: small. Mouth: broad. Front feet: 4 toes; hind, 5. Feet: with 2 tubercles on under side. Blackish brown, with large, irregular, yellow to olive blotches.	Length: to 6 inches. Greenish or brownish black with bright yellow, round dots. Shining, moist, and when handled roughly, mucus-covered. Tail: 2.33 times in the length. Indistinct tubercles on hands and feet. Grooves on sides: 10 or 11. No external gills in the adult. Several clusters of enlarged pores on head.
Range: Eastern Canada and New England to Wisconsin and south to Florida, the Gulf States, Texas and Missouri. Related to the Red-backed Salamander (which see). Commonest, in shady ravines, being found in daytime under logs and stones or, in rains, sometimes wandering about in open.	Range: from southern Canada in the east, south to Georgia, and west to Illinois and Louisiana. In their range, Dusky Salamanders are often common near heads of streams or about springs where their burrows may be easily dug to water. It may swim readily in water but does not ordinarily seek open water except as larvae.	Range: From eastern Canada, through the United States east of the Mississippi, and also through Missouri. American species of genus, 14, through United States and northern Mexico. Red-backed or Lead-backed commonly found under logs or dry rocks, usually in rocky woodlands, rarely in open or in water.	See Spotted Salamander for discussion of relatives. Tiger Salamanders found widely distributed over most of the United States east of the Rockies and extending to the south over the northern part of the Mexican highlands. Some found west to California. Adults found under stones and logs in rather moist places.	In field, woodlands, cellars and under boards in summer and winter; in smaller pools, in early spring. Other species of *Ambystoma* include the Jefferson's, the Marbled, the Tiger and the Mole Salamanders. Spotted Salamander ranges from Nova Scotia to Wisconsin and south to Texas and Georgia.
Few details of life history known. Creamy-white eggs reported from Arkansas caves, late Aug.-early Sept., female coiled about eggs under rotted stump in West Va. reported by Sherman, authority respectively Noble and Marshall, and Fowler.	Eggs: 12 to 26, .16-inch, in 3 jelly coats, like a bunch of about 20 grapes, yellow-white, laid from June through September, in wet moss, under logs or stones, where it is wet, usually surrounded by female; develop to .5-inch length in egg in 2 months. Continues 9 months as aquatic larva before transforming.	Sexes mate in fall, and eggs laid late in following spring. Eggs: about 12, .2-inch, in 3 jelly coats, found commonly under wet wood encircled by mother. Larval stage spent in the egg, the young having gills only a short time after hatching. Young: 1 inch long when hatched, and soon independent of parent.	Following courtship, eggs, to 75, are laid in a jelly mass similar in general to those of the Spotted Salamander. The egg mass is about 4 inches across and is attached to submerged weeds or sticks. The larvae have gills and live in the water through the summer but lose them and take up life on land in 3 months.	Sexes migrate to pools in spring, at night, mate. Male deposits mucus sperm holder. Female visits then deposits mass of 130 to 225 eggs. Each egg, in 2 jelly coats, hatches, 2 to 4 weeks. Egg mass, attached. Larvae: .5 inch long when hatched, remain with gills in water until late summer, then assume adult form on land.
Food: largely insects and their larvae; also spiders, worms, millipedes and similar small creatures. The species is nocturnal and is entirely terrestrial throughout its life, apparently. Protection against some enemies is effected through excretion of abundance of distasteful mucus when annoyed. Sometimes prey of Short-tailed Shrew.	Food: probably exclusively small forms of animals and probably mostly, when living, caught in the crevices and wet places where the animal lives. While the slippery nature of the body may serve as some protection it is not developed to the degree found in the slimy salamander, nor can the tail be shed so readily as in the two-lined salamander.	Food: insects and their larvae captured by flat tongue which can be projected forward quickly and accurately. Can secrete a slime but only in small quantities. If held, may shed tail readily and tail may continue to move for some time. Regenerated tail is without vertebrae.	Food: essentially that of the Spotted Salamander, namely small animals caught at night by prowling around on the ground. In captivity, it may eat small frogs. In some parts of western United States and in lakes around Mexico City, Tiger Salamanders may retain their gills and their aquatic habits through life as "permanent larvae."	Food: largely insects, snails, slugs, worms. In aquaria, may be fed raw meat in small quantities on toothpick, or earthworms or mealworms. Larvae thrive in aquaria where temperature is about 65°F. Transformation of larvae indicated by absorption of gills in late summer or early fall. Spring appearance may be before ice leaves water.
Probably of little economic importance but what it does in the destruction of insects found about decaying wood may be useful in keeping such creatures in control. Makes interesting terrarium pet but usually remains deeply burrowed during the day. More details on breeding habits will reward careful study.	Possibly useful as a check on insects of its habitat. Unfortunately, the insects eaten may have become contaminated with colon bacteria by eating sewage and the salamander may serve as a reservoir for contaminating drinking water. In 122 days, one produced enough colon bacteria daily to contaminate 237 gallons of water.	Possibly useful in keeping certain insects and their larvae in check. Makes most interesting terrarium pet but should not be allowed to starve in such a situation. Every school child should have at some time opportunity to see a mother Red-backed Salamander in her nest with her eggs; better yet, find such a nest independently.	Economic importance about the same as that of the Spotted Salamander, though the animal may be more popular for sale as terrarium pet. To biologists, they are interesting because some retain gills through breeding adult life while others lose them at this stage of development. Larval form was known as the *Axolotl*.	Useful destroyer of many kinds of small animals, some of which are injurious. May eat insects infected with disease. Makes an interesting terrarium pet and the eggs are commonly brought into school rooms in spring as "frog's eggs" with the result, of course, that frogs do not hatch from them. To avoid this, watch for double film on eggs.

COMMON NAME SCIENTIFIC NAME	SPRING PEEPER *Hyla crucifer*	TREE FROG *Hyla versicolor*	CRICKET FROG *Acris gryllus*	TOAD *Bufo americanus*
DESCRIPTION	Length: male, to 1.15 inches; female, to 1.3 inches. Long-legged, broad, and flattened. Toes: with sticky discs at the tips. Male, yellow on groin; throat, brown or yellow. Female, with white throat. Back: with irregular dark X and dark spots. Legs: with dark cross-bands. Female, in general, lighter in color.	Length: male, to 2 inches; female, to 2.4 inches. Ashy gray, to pale brown, varying with environment. Skin: finely pimpled. Legs: slender, and toes ending in discs which stick to surface. Back and legs: marked with dark areas which are commonly black-bordered. Often orange under hind-parts.	Length: male, to 1.16 inches; female, to 1.3 inches. Looks like a true frog instead of like a tree frog, being more slender, with smoother skin and with more normal toes. A dark triangle between eyes, with a white border behind. There is an oblique, white stripe from eye to arm. Color varies, brown, reddish, gray, green.	Length: to 4.25 inches long. Male: rarely over 3.5 inches long; female, longer. Fat. Skin, roughened by pairs of dark spots on the back, each surrounding a wart. Undersides: finely roughened, with some dark spots there also. Eyes: prominent. Some males have yellow throats and yellow on under side. Two large glands back of eyes and neck.
RELATIONSHIPS AND RANGE	Range, from New Brunswick to Manitoba, and south to South Carolina, Louisiana, Arkansas and Kansas. In spring, found about shallow pools where breeding takes place, but during summer, may be in tree tops for most of the time and, in winter, hidden in forest floor. May be heard from woodlands any month of year.	Maine, through southern Canada, to Minnesota, south to Gulf States, including parts of Texas and Arkansas. Related American species, 11, cover United States and into Mexico and southern British Columbia. Included in related species, are the Peeper, Pacific tree frog and others. Lives in tree tops in summer.	Ranges from Florida to New York and Connecticut, west to Texas and northward through the most of the upper Mississippi valley states. It lives on the ground, lacking sticky toes, and haunts meadows, waterway margins or woodland margins where there is moisture.	Eastern North America, from Great Bear Lake to Mexico and east from the Rockies, with 13 other species extending range from northern Mexico and Lower California to British Columbia. Common in gardens, about lawns, in cultivated fields and in waste places where loose soil is suitable for self and for favored food.
REPRODUCTION	Male precedes female to breeding pond in spring. After the mating, 800 to 1,000 black and white, one-coated, .08-inch eggs are laid, under water, on vegetation, singly. These hatch in 5 to 15 days, and in 75 to 90 days, develop into 1.3-inch tadpoles, with many purple-black blotches, and iridescent creamy bellies. See below.	Eggs: .04-inch, brown and yellow, in one, thin, and one, loose, jelly coat, laid free, or attached, at water surface, in films of 4 to 25, though individual lays 1,500 to 2,000; hatch in 4 to 5 days, into red- or orange-tailed, creamy-white bellied tadpoles, which in 40 to 60 days, are 1.8-inch long, and transform into .6-inch frogs.	Breeds from February through October. Eggs: to 250, .04-inch, with single, jelly coat, attached to submerged vegetation; hatch in 5 to 15 days, into tadpoles which, in 60 to 75 days, are 1.7 inches long, with black-tipped tails, long breathing tubes on left side; transform into .5-inch adults which take to land.	Breeds in mid-spring to midsummer. Eggs: .08-inch, black and white, in two-coated strings of jelly, laid beneath water surface, among weeds, 4,000 to 7,000, hatch in 3 to 12 days, into black tadpoles, with looped, external gills. In 40 to 60 days, when tadpoles are .4-inch long, they transform and come onto land as little toads which mature in 2-3 years.
FOOD	Food: of adults, essentially insects caught by quick thrust of the tongue. The 1.3-inch tadpole transforms, in July, into .6-inch, tree frog which leaves the water and probably spends to 3 to 4 years before reaching sexual maturity. Has many enemies including birds, fishes, salamanders, squirrels and other animals.	Food: essentially insects, caught by lightning dart of tongue. In North, a tree frog which transforms at .6 inch is 1 inch at 1 year; 1.4 inches at 2 years; 1.8 inches at 3 years when it reaches breeding maturity. Can cling securely, to clean, vertical glass. Song: a short melodious trill.	Food: insects, and other small animals of their environment, caught by quick thrust of sticky tongue. Males may jump 3 feet at a time, or leap to 1 foot high into bushes after food. Time to reach sexual maturity after transforming not known to author. Song: like a metal rattle giving rapidly repeated "clicks."	Food: cutworms, potato beetles, chinch bugs, earthworms, ants, slugs, or almost any animal moving in vicinity, all caught by quick thrust of tongue. Can exude slime which is distasteful to many enemies, but not poisonous to man, though giant toad of the tropics may cause great suffering or blindness to dogs or man. Song: a prolonged musical trill.
ECONOMIC IMPORTANCE	Essentially, useful as check on insects of the environment and a delightful animal for life in terrarium, but, more particularly, free in the open. May be fed chopped earthworm if kept through winter in terrarium when it does not hibernate as in nature. Peeping done by the male only.	Entirely useful animal of thickets, orchards and shade trees, some having been caught 60 feet up in a tulip tree. Most active at dusk and, since it sings during damp weather or before rain, many people consider it reliable weather prophet. Throat inflated conspicuously when in song.	Use to man, probably negligible, except that it serves to check multiplication of insects of its region and serves as food and as bait for fish. Sounds are difficult to trace and often come from surprising quarters, with startling suddenness and most interesting results.	One of the most useful animals associated with man and his crops. One of the best residents of any garden. In China, skin is used as a medicine, not unwisely, since it contains adrenalin which increases man's blood pressure. May live to 36 years. Can not live for ages, confined in a rock, as many believe. Does not cause warts on man.

BULLFROG *Rana catesbeiana*	GREEN FROG SPRING FROG *Rana clamitans*	PICKEREL FROG SPRING FROG *Rana palustris*	LEOPARD FROG MEADOW FROG *Rana pipiens*	WOOD FROG *Rana sylvatica*
Length: male, to 7:5 inches; female, to 8 inches. Hind legs may be over 10 inches long. "Ear" larger than eye. Throat: sometimes yellow in male, while ear is as large as eye, and throat is white in female. In both sexes there is a conspicuous wrinkle or fold running down behind "ear," but not down the back.	Length: to 4 inches, with sexes about equal. Male: with "ear" larger than eye; and throat, usually orange. Female: with ear and eye equal, and throat white. Both with a prominent fold extending from each eye, almost to base of hind leg, with a branch at right angles behind the "ear."	Length: male, to 2.6 inches; female, to 3.2 inches. Male croaks, has swollen thumb at breeding season, and has small swellings between "ear" and arm. Much like Meadow Frog, but yellow or orange under hindparts and dark spots are squarish, black-bordered, and regularly arranged in 2 rows, sometimes with a third incomplete row.	Length: male, to 3.2 inches; female, to 4.1 inches. Male, with fold of skin over arms. Female, without such fold. Male, sometimes with swollen thumb. Skin, smooth, generally moist. Green, with whitish-edged, dark, irregular blotches. White beneath. Toes: not webbed to their tips.	Length: male, to 2.2 inches; female, to 2.6 inches. Conspicuous, because of black mask across lower part of eyes and side of head. Skin: smooth, moist and highly variable in color, from light tan, through green, to almost black. Legs: long and slender. Male, with convex webs on hind feet in breeding season; croaks.
Ranges through most of North America, east of the Rocky Mountains. It lives in the water through its life, not roaming far into fields or into tree-tops as do many other kinds of smaller frogs. It favors small lakes and ponds where there is little wave action, a mud bottom, and good depth, as in mill ponds and reservoirs.	Ranges through eastern North America from Canada to Florida. This frog lives in or within jumping distance of water through its entire life. It haunts small pools, ponds, streams, swamps and lakes. It hibernates in the water, sometimes in burrow. In some places protected by law in breeding season.	From Hudson Bay to Arkansas and Louisiana and through all the Eastern States, with related species to the west. Common, in marl ponds, rocky streams, small ponds and marshes but rarely wandering far from water, as do the Meadow Frogs. Winters in marshes, ponds and springs. Does not climb into trees as do the Tree Frogs.	Through North America, east of the Sierras, from southern Canada into northern Mexico. Common, in spring in the marshes, ponds and shallow pools of the country, but in summer takes to swamplands, meadows, grassy woods, cultivated fields. In winter, hibernates in marshes and pools.	Ranges from Quebec and Nova Scotia to South Carolina, west to Great Plains, with related species on to the west and far north. Lives mostly in wooded areas, breeding in spring, in woodland ponds, spending summer and fall on forest floor, and winter under stones, stumps and logs in woodlands, not in the water.
Mates from February (South) to July (North). Eggs: .02- to .04-inch, in several, 3-5-foot, surface films, usually attached, total to 20,000, black and white, in one, thick coat of loose jelly; hatch in 4 days and develop (North) in 2 years into 5.8-inch tadpoles, with irregularly spotted tails and yellow, not iridescent bellies. See below.	Mates (North) through summer. Eggs: .06-inch, black and white, in a thin-oval and thick, spherical, loose jelly coat, in disc-like 1-foot surface films, totalling 4,000 in several films; hatch in 3 to 6 days and develop in 1 year into 3.4-inch tadpoles, with green tails, with brown spots, and creamy, not iridescent, bellies. See below.	Breeds (North) April, in great numbers, in ponds. Eggs: brown and bright yellow, .06-inch, in a thin, and a thick, firm, jelly coat, in globular, free, or attached, underwater masses, to 3,000; hatch in 6 to 19 days and develop in 70 to 90 days into 3-inch tadpoles with dark purple opaque tail-crests and iridescent bellies. See below.	Breeds (North) April. Eggs: .06-inch, black and white, in a thin and a thick coat of firm jelly, attached, under water, in long masses, totalling to 4,500; hatch in 4 to 20 days, and develop, in 75 to 90 days, into 3.4-inch tadpoles, with high tail-crests, translucent, with fine markings, and bronzy, creamy iridescent bellies. See below.	Mates, April (North). Eggs: .1- to .06-inch black and white, in 2 thick, firm jelly coats, in several spheres, free or attached, under water, to 3,000; hatch in 4 to 24 days, and develop in 44 to 85 days into 1.8-inch tadpoles, with creamy lines along upper jaws, and pink bellies, with bronze iridescence, then transform. See below.
Food: of tadpoles, oozes and aquatic plants and animals; of adults, insects, fish, other frogs, birds and other animals. Tadpoles transform into 2-inch frogs which grow to 2.6 inches in 1 year; 3.25 in 2 years; 4 in 3 years; 4.75 in 4 years; and 7 in 7 years. Reaches breeding size of 5 inches in fifth year after transformation.	Food: almost any animal that can be swallowed by the adult. Tadpole eats oozes and slimes and waste plants and animals. Call: an explosive "Chung" or a scream. Tadpole transforms into 1.3-inch frogs, which average in 1 year 1.8 inches; in 2, 2.25; in 3, 2.85; and in 4, 3.5 inches. Breeds at about 3-inch length.	Food: of tadpoles, oozes and slimes and plants and animals; of the adult, insects and other small animals. The tadpoles transform into 1-inch frogs in mid-summer, which reach 1.5 inches in 1 year; 1.8 in 2 years; 2.3 in 3 years; and 2.6 in 4 years, becoming of breeding age in third year. Call: a short, grating croak.	Food: of tadpoles, oozes and slimes of plant or animal material; of adults, insects, worms and other small animals. Tadpoles transform in midsummer into 1-inch frogs which average 1.5 inches in 1 year; 2 at 2 years; 2.35 at 3 years; and 2.7 at 4 years; the breeding size being reached at 3 years. Call, a short clacking grunt.	Food: small animals of the forest floor; and, as tadpoles, the oozes and slimes of the breeding ponds. The tadpoles transform into .6-inch frogs in early summer. These become 1 inch long at 1 year; 1.3 at 2 years; 1.8 at 3 years and 2.25 at 4 years, when they reach breeding maturity. Calls: clacking croaks, by the males.
Excellent scavenger. Legs bring 1 cent a pair which, in North is from animal requiring 7 or 8 years from egg to egg. Advertised "frog farms" are of questionable merit unless there is a "sucker" market for breeders at advertised price of $6.66 a pair. Call, a booming "jug-o-rum" by male. Protected by law in season in some states.	Legs sold on market at about 1 cent a pair for animals requiring, in North, 4 to 5 years from egg to egg. Protected by law in breeding season in some states. For information on utilizing frogs, see United States Bureau of Fisheries, Document 888, on "Frogs: Their Natural History and Utilization."	Skin secretes substance highly irritating to mouths of dogs. Will kill other frogs in same jar. The legs are edible in spite of the fact that, by some, they are considered poisonous. Animals are unquestionably more useful alive as insect eaters and as food for valuable food fishes than they are as food for man.	The legs are used as food but the animal is worth much more alive as an insect destroyer than dead at 1 cent per pair of legs. Frogs, less than breeding age, should never be killed. This species is protected by law during breeding season in some states and should have this protection generally.	It is questionable if this frog gets large enough to be considered of food value to man. Its value alive in the woods as an insect destroyer and as a food for larger animals, including the fur-bearers, must be more than it could possibly be worth dead to man. Important enemies include cats, rats, weasels, crows, muskrats, and so on.

(Continued from page 307) edge, but soon becoming thoroughly aquatic. The adult stage is spent mostly on the land. In the newt, the eggs are laid in the water and an early larval stage is spent there. By late summer or fall, the young animal comes out on land as a red eft that may live for a varied period of time. This land stage may last as long as three years, or be wholly lacking. Then, when mature, the animal assumes the brown color and the flattened tail of the adult and returns to the water. So different are these two stages of the same animal that for years they were thought to be two separate species. In the early larval stages of most salamanders, the food may probably be oozes and slimes found near the hatching place.

A most excellent book, *Handbook of Salamanders* by Sherman C. Bishop, has been published by the Comstock Publishing Company. It is unique in its field. It has excellent illustrations taken from living animals, and life-history keys.

Frogs and Toads

When spring comes, one of the first signs of the season is the calling of some frog or toad. In southern California, this may begin by Christmas time. In Jamaica, the frog chorus is at its height when Christmas gifts and firecrackers are being distributed. From then on through the year, some one or another of these animals may be heard. Peepers, or some other frog or toad, have been heard in Ithaca, New York, in every month of the year.

The sounds heard in the choruses are produced almost wholly by the males. Females of some species may produce sounds when disturbed or injured, but they do not sing to call their mates to a love tryst. The males are usually smaller than the females, have black or colored throats rather than the lily-whiteness usually reserved for the fair sex, and come to the breeding grounds in advance of the females.

Each species of frog and toad has its own distinctive song that may be recognized as such by the specialist. And since each species also has a more or less restricted range, a naturalist frequently gets a real thrill from attending a movie whose locale is supposed to be New England only to hear southern California frog sounds used to indicate "night in a swamp." It should not be difficult to learn to recognize the sounds of the relatively few species any locality has. Since few species sing over a long span of time, there is less likelihood of confusion such as comes to those who try to learn to recognize birds' songs when the spring migration is at its height.

Usually, the spring chorus is opened by the peepers or by some of their close relatives. As the season progresses, these are joined by the wood frogs, pickerel and meadow frogs, and followed by the tree frogs and the common toads. When the "Tschunk" of a green frog can be heard, spring is well advanced and summer is not far away. Neither is the bellowing "jug-o-rum" of the bull frog, which is usually the last species to appear and to breed.

While some frogs, particularly in the tropics, lay their eggs in wet trash on the ground, most species deposit them in the water. In the North, the earlier-laying species usually place the eggs in the deeper water where there is less danger of freezing, while the green frogs and bull frogs, the last to lay, deposit them in great masses that float at or near the surface. As a rule, the earlier species lay fewer eggs than the later species, and their tadpoles mature to the transforming period in the same season. In the North, at least, the later-appearing species produce tadpoles that live through one or more winters before transforming into the hopping form.

In the larval or tadpole stage, the animals feed largely on the oozes and slimes to be found on the submerged objects about them. Some may live as scavengers. When the time for transformation comes, the tadpoles do not shed the tails as some would believe but absorb them during the time the change is being made. With the toads, at least, great numbers may transform at a given time, frequently during the time near a shower. Because of this many believe that it has "rained down" toads. It is quite probable that the incident referred to in Exodus took place in early summer when frogs and their relatives were transforming.

One cannot assume that once a tadpole has become like a frog its troubles are over and it is ready to reproduce its kind. In the North it takes a wood frog four years to reach sexual maturity; a tree frog, pickerel frog, leopard frog or green frog three years after transformation; a bull frog, five or six years. If the numbers of a species are to be maintained, the animals smaller than the breeding adults must be protected.

There are laws designed to protect frogs in their breeding territory and during their breeding season. In some states, at least, they cannot be driven into compounds and slaughtered, nor can they be prevented from reaching their breeding grounds.

There have been many "get-rich-quick" schemes built around the food value of frogs but most of them are so patently impractical that no sensible person would be caught by them. One southern firm with whom I corresponded boasted that their frogs were especially selected to be quiet and not bother the neighbors, and they guaranteed that the frogs would make no more noise than a dog or cat. When I asked permission to visit one of the farms of their customers anywhere in the Northeast, I was told that I should appreciate how annoying it would be to have every one visit my frog farm, were it successful, and therefore I could not expect others to let me see their farms. This particular firm has, I understand, gone out of business because of its abuse of the United States mails.

For my own part, I much prefer to listen to a frog chorus than to sink my teeth into the muscles of a few frog's legs and I hope that there will always be places where I can hear the sounds of these animals in season. As a college senior, who was once one of my students, wrote:

"Somewhere there is a hyla song
Piping clear, and sweet and thin.
Tonight if you knocked at the door of my heart,
Tonight, I would let you in."

She was criticised by the English department for mentioning hyla with which the instructor was unfamiliar. I doubt if he would have been better satisfied had she substituted the word "peeper."

If you are interested in knowing more about frogs and toads from a book, get *Handbook of Frogs and Toads,* by Anna Allen Wright and Albert Hazen Wright, The Comstock Publishing Company, or the U. S. Bureau of Fisheries Document, No. 888, *Frogs: Their Natural History and Utilization.*

The Ohio Fox Hunt

When, in its issue of March 13, the magazine *Life* published a series of pictures of a "circle fox hunt" in Holmes County, Ohio, it swelled its incoming mail by nearly four thousand letters. Most of these were bitter in their condemnation of the cruelty and sadism pictured. They revealed that traditional American sympathy for the "under dog," and a revulsion of feeling against cruelty. A "circle hunt" consists in forming a huge circle of participants around an area where the prey is numerous, gradually drawing in the circle until the beleaguered animals are completely surrounded and can be dispatched with clubs, or otherwise.

Our reaction to this picture feature was, of course, that of the majority, and our sympathy was all with the fox. We wrote to *Life* commending this exposé, at the same time pointing out certain inaccuracies in the brief text matter that accompanied the pictures. We also wrote to our members in Holmes County for their opinion of these hunts, and any additional details and facts. We discovered that there are two sides to the story, and feel that, for the record, they should be fairly stated.

First, it is pertinent to point out that *Life* said that the Holmes County farmers killed the foxes because they killed the quail, which the farmers wanted to shoot themselves. Quail have been continuously on the protected list in Ohio since 1913. *Life* said that the farmers could not shoot or trap the foxes without licenses, which most of them did not have. Foxes are not protected in Ohio and no license is required to shoot or trap them. Also, farmers do not need licenses to take game animals on their own property. *Life* said that the hunters get the foxes out of their holes by "yelling and baying." Such a row would send the animals deeper in their dens. A fox is no fool.

So much for the text. As to the pictures, *Life's* photographer was out to get an arousing feature—and certainly succeeded. From the testimony of our members it seems true that the ostensible inclusion of children in the clubbing of the fox was the photographer's idea, although the fox was already dead when the youngsters were so posed. These pictures unquestionably stimulated much of the protest. However, there were plenty of children in the circle hunt, obviously enjoying the excitement, and, in our opinion, this is no way to bring up children.

In fairness to the people of Holmes County it must be said that unquestionably there is an over-population of foxes there. They have no natural enemies and have increased. The county includes 2286 farms, on 2093 of which poultry is raised. This industry is the second most important source of income for the farmers, bringing in $1,715,402 in 1942. In 1943 an average loss of 41 birds per farm is charged against the foxes, or more than 80,000 birds for the county.

These figures are quoted by the Millersburg Chamber of Commerce, which states: "We regret that this method of control has been construed as being cruel and inhumane. In the normal course of the circle hunt the animal is not subjected to prolonged suffering but is quickly dispatched. . . . We will gladly welcome any constructive suggestions as to a more humane and effective method of controlling the fox population."

The only really effective alternative is, of course, trapping, but there is nothing humane about the steel trap, where the animal may suffer for hours and have to be killed by a club in the end, as one of our members, Mrs. Edythe G. Low of Millersburg, points out.

Another member, Mrs. Harve O. Parsons, of Nashville, Ohio, says: "The account of the hunt was so exaggerated that one could hardly recognize it as a Holmes County fox hunt. . . . Foxes have become so thick in the county that a chicken raiser either would have to move out and let the foxes take over, or get out of the chicken business." Mrs. Parsons, who is a lover of wildlife and actively interested in conservation, adds:

"I think I am safe in saying that there are very few people in the county who would want all foxes killed. They are a part of our natural wildlife here and we are proud of them. There is nothing more beautiful to see than a fox coming out of the thick woods early in the morning. There is nothing more weird than a wild fox bark back in a lonely hollow. There never was a roundup hunt held while foxes were scarce, and very little shooting of them. But if Nature is the survival of the fittest, and foxes are allowed to continue to increase here, the fox will surely be the fittest."

The editor of the *Farmer-Hub* of Millersburg asserts that *Life* was invited to come and photograph the circle hunt, and that in so doing its representatives violated hospitality, misrepresented the affair and built a horror story in picture. We are not in a position to judge this.

It seems to us that the whole affair simmers down to the fact that Holmes County farmers were confronted with an economic problem of too many foxes. They adopted a method of control and some found sport in it. If it had been approached as a distasteful job that had to be done, it would be excusable, but this was obviously not the local attitude. So, closing the book on the Holmes County fox hunt, may we again point out that most conservation agencies have specialists in wildlife management and control. An area with a fox problem of this sort—or of any similar sort—should report the situation and call in experts. A "circle fox hunt" is, in our opinion, un-American as a sport and a degenerative influence, particularly on the young, in whom lies most of our hope for wildlife conservation.

Bird Man of Minnesota

By VIRGINIA L. DUSTIN

On the fourteenth day of June, 1867, a large river steamer churned its way between the high wooded bluffs of the upper Mississippi River, then, its engines throttled, eased slowly to the Saint Paul landing. Among the passengers who disembarked that day were the Roberts family from Philadelphia. They had come, after a long rail and water journey, to the midwest frontier.

They stopped for a moment to look about. It was primitive forest here, real frontier country, and nothing at all like the settled, civilized Philadelphia from which they had come. It had been the same all the way up from Dubuque except that here the bluffs were higher and a little more rugged. The valley was wide and open, covered from bluff to bluff with a carpet of heavy green forest.

The father, John Roberts, like Thoreau and hundreds of other invalids in the sixties and seventies, had been advised to go to Minnesota for his health. After a month of prospecting, the family moved to Minneapolis, another village ten miles up the river. John Roberts was supposed to keep out in the open, so as soon as possible he acquired a horse and buggy, a gun and dog, and began to take exploring trips into the surrounding country. With him, as companion, he took his older son, Thomas Sadler Roberts, nine years old, lively and inquisitive, and interested in everything around him.

There was plenty for them to see, for the forests, which grew to the very edge of town, were teeming with birds and other wild life. Deer browsed undisturbed on the banks of Lake Calhoun, now in the heart of Minneapolis parkways, and ducks made their nests in the reeds along the shore.

They saw the upland plover, nesting by the hundreds at Fort Snelling Military Reservation, and in the spring and fall they watched the golden plover settling in clouds on the prairies south of town. They saw the wonderful flight of the passenger pigeon, the birds coming in April to gorge on the acorns in the oak groves near Lake Johanna.

Tumbling out of school in the afternoon, young Tom Roberts often found his father waiting with the horse and buggy, ready for another trip to the woods. Neither father nor son ever tired of these journeys, which gradually extended to distant points

Dr. Thomas Sadler Roberts, Minnesota physician and ornithologist, and author of *Birds of Minnesota*. Eighty-six years old this year, his interest in bird life is unflagging.

throughout the state. They continued until the boy was grown. Between the two was a rare companionship, broken only by the death of John Roberts in 1891.

Like all boys, Tom Roberts soon began collecting things—birds' eggs, butterflies, lichens—typical boy loot that he brought home from the woods and stored in his bedroom. Then, in 1874, a young scientist named Franklin Benner, who had come from New York on a midwest collecting trip, showed him how to make a professional bird skin. After that his interest settled principally on birds, and at the end of two years he had a collection of some six hundred specimens.

Besides his father, there were other skilled men who were ready to help an eager young collector. One of these was Dr. Philo Hatch, physician and state ornithologist, whose lack of method was offset by a warm, contagious love of birds. Another was

W. L. Tiffany, sportsman and miller from New Jersey, who gave the boy his first work on ornithology, *The Birds of North America*, by Baird, Cassin, and Lawrence. Busy professional men, they were ready at the drop of a hat to talk birds, or go out chasing after some elusive specimen.

As his hobby grew, the boy's bedroom became cluttered with stuff—specimens, filing cases, work tables—more like a museum, he says today, than ordinary sleeping quarters. His chums, too, liked to work in this room, and soon it became official headquarters for a thriving Nature-study club, known, rather imposingly, as the YOUNG NATURALISTS' SOCIETY. There were five boys in the club, all, like Tom, keen on some branch of outdoor life. Organized on February 12, 1876, they met here regularly for a period of three or four years, collecting, stuffing and swapping specimens and, what is more unusual, making accurate and detailed records of their finds.

The Museum of Natural History at the University of Minnesota. Dr. Roberts presides as its director.

At least three of the group became distinguished scientists. There was Tom Roberts, of course, who emerged as physician and ornithologist; Robert S. Williams, who started with birds and wound up as an international moss expert at the New York Botanical Gardens. And there was gifted Clarence Herrick, who could draw and do many things superlatively well, who became a famous neurologist and biologist, and founder and first president of the University of New Mexico.

At nineteen Thomas Roberts entered the University of Minnesota, then a small institution just rearing its head above the Minnesota prairie. It boasted two buildings, a student body of 371, and some notable faculty members. He stayed there two years, until illness stepped in and forced him to give up schoolwork for a time. He took an outdoor job as land examiner for the railroads and gradually built up his health.

By 1882 he was feeling fit again, and had made up his mind that he wanted to become a doctor. So that fall he went east and enrolled as a medical student at the University of Pennsylvania. It was a rigid course that took three years to complete.

Fortified with a diploma, and after an interneship in two Philadelphia hospitals, the young doctor came back to Minneapolis and hung up his shingle on a busy downtown street. But after a year in the bustle of the loop district, Dr. Roberts decided to follow the custom of the physicians in Philadelphia, and moved his office to his home in an outlying residential district.

Now his patients claimed him. For the next ten or twelve years his days were a crowded routine of office hours, calls and operations. He saw patients at his office. He visited endlessly at homes and hospitals. He taught at the University, first as professor of pediatrics, then as clinical professor. He was chief of staff at St. Barnabas hospital. Birds, which had always been a passionate interest, sank for a time to a minor role.

Even during the busiest years, however, he managed to read two or three bird magazines, and keep up an intensive correspondence with other ornithologists throughout Minnesota and farther afield. When he was able to snatch a short vacation he spent it in field trips to different areas within the state.

In 1915, after nearly thirty years of medicine, Dr. Roberts planned to retire. Two things, however, conspired against him. The first was a group of patients, who, recognizing in the doctor a friend and counselor as well as a physician, refused to let him go. Representing some twenty-five families, they organized a Dr. Roberts trust, with the proviso that he continue as their personal physician. The second was a letter from Dr. Vincent, president of the University of Minnesota, asking him to come over to the campus as director of the University Museum of Natural History. Nearing sixty, Dr. Roberts entered on an entirely new and absorbing career.

Since his day as a student, the University had grown into a great institution crowning the bluffs above the river. But the Museum was still a campus stepchild, shunted about in odd corners of the science buildings, and fostered, at the moment, by the Department of Biology. When Dr. Roberts took over, he brought with him his collection of bird skins, which were kept, for the first year at least, in the basement of the anatomy building, while the Museum proper was in Pillsbury Hall and the office in Millard Hall. Next year, however, a new biology building sprang up on the south side of the campus, and, moving in, the Museum found itself for the first time housed under one roof. A small but expert staff was formed, and slowly the Museum began to grow.

The biology students, better than anyone else, knew what was going on at the Museum. Hurrying

in and out of class, they watched, with companionable interest, the preparation and installation of each new habitat group, and each new display case. They liked the small grouse that scurried through the grass of the prairie group. They liked the bear cubs romping in a north shore cove. Behind the glass everything was startlingly real, so real they could almost smell the wintergreen berries growing on the forest floor, or hear the song from the bird on a twig.

The public came, in ever increasing numbers, drawn by the exhibits and the popular Sunday afternoon lectures. The school children came, too, herded by their teachers through the museum halls. They stood wide-eyed in front of the beautiful deer group, or listened intently as Dr. Roberts told the story of the passenger pigeon, now gone forever.

If growth came slowly at first, it was due principally to lack of the available funds. The budget supplied by the University was woefully small, inadequate even for operating expenses. But help came from a group of the doctor's friends. Valuing his friendship highly and wishing to express their affection in something more tangible than words, they contributed to the growth of the Museum, either in the form of operating expenses or as funds to provide new collections and habitat groups. One of the largest contributors was James Ford Bell of Minneapolis.

It was largely through Mr. Bell's efforts that the present day Museum of Natural History came into being. For years such an independent building had been dreamed of, planned for. It was in 1938 that the plans were finally completed, and, with the help of the PWA, ground was broken and construction begun. It stands today near the center of the oak-covered campus, a striking building of Bedford sandstone, in which form and function are beautifully correlated. It houses studios, workshops, display groups, lecture halls and offices, and there is plenty of room to grow.

It was during the struggling years of the Museum that Dr. Roberts began work on the book that has won him international fame—the beautiful, scholarly, two-volume *Birds of Minnesota.* The need for the book existed long before it was written, but it had been put off as an heroic as well as a costly undertaking. One thing was agreed upon—Dr. Roberts was the man to write it. He was endowed with an enthusiastic zeal for the welfare of the birds, knowledge and scientific background.

At length a group of donors guaranteed the funds necessary to see the book through publication. The writing began, a gargantuan task of assembling, sorting and verifying every fact in a mountain of literature. The author drew not only on the records of countless trustworthy bird observers throughout the state, but on his own journals and diaries, which he had systematically kept since his boyhood. As Dr. Roberts says, it took fifty years to collect the material for the book, but only four and a half years to write it. The foremost bird artists were called in for illustration—George Miksch Sutton, Allan Brooks, Walter Alois Weber, Francis Lee Jaques, Walter J. Breckenridge, and there was one plate by the late Louis Agassiz Fuertes. Appearing in 1932, *Birds of Minnesota* is considered one of the most beautiful and complete state bird books ever published. To its author it brought the gold Brewster Medal of the American Ornithologists' Union.

In late years several other volumes have come from his pen: *Manual for the Identification of the Birds of Minnesota and Neighboring States* (1932), *Bird Portraits in Color* (1936) and *Log Book of Minnesota Bird Life* (1938) and *Annals of the Museum of Natural History* (1939).

This year, in February, Dr. Roberts celebrated his eighty-sixth birthday. But despite the calendar, the years have not abated his vivid enthusiasm, nor dulled the twinkle of his clear blue eyes. There seems to be only one thing he has had to moderate, and that is his passion for field trips and bird hikes. For twenty-seven years he has conducted a bird class under the auspices of the zoology department. He found the contact with youthful students stimulating and helpful, and the basis of many lasting friendships.

But from his third-floor offices he still directs the multifold activities of the beautiful University Museum. As a doctor, he prescribes and cares for several patients who will consult no other physician.

The University has conferred on him the red hood of an honorary D.Sc., and numerous learned societies have put signal approval upon the doctor's work. But while he appreciates them, Dr. Roberts wears his honors lightly and keeps his diplomas in a drawer.

★

The Empty Bird Bath

By W. F. JENKINS

I built my nest on faith as real
As any of your kind;
Did you forget, or did you feel
Your promise did not bind?

Lion and Lacewing Lore

By EDNA PECK ATWOOD

Illustrated by the Author

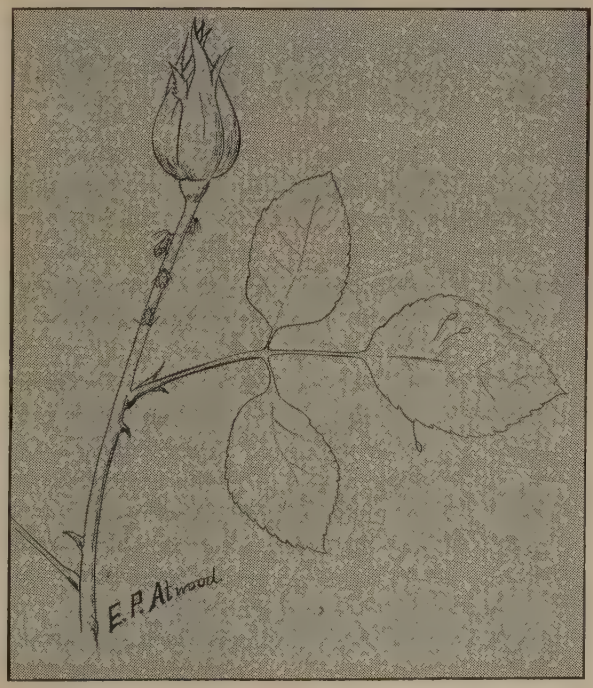
My small neighbor, being rebuked by his parent for coining a childish disrespect, logically argued: "But she's GOT to have a NAME." So it is with everything. Quite often the name is not altogether fitting.

Take the aphis lion, so named because of its fierce appetite for aphids. It resembles a lion in nothing but temperament. First it is an egg, then a crawling larva, then a sleeping pupa inside a cocoon, and lastly an adult winged insect that may lay eggs, if of proper sex, and start the cycle anew. During adult life it bears the alias of lacewing fly. Yet it is the same lion, cocoon-processed and outwardly transformed.

Since an aphis lion is our friend and ally, let us get acquainted with it. In its way it is as fantastic as the colossal, man-headed, winged lion that grew out of the imaginative brain of the ancient Assyrian, and became thought-turned-to-stone under the hand of a master sculptor. That creation was Nergal, god of war, pestilence, the chase, and the burning midsummer sun. He was also lord of the dead. All of these things, to his victims, is this diminutive Nergal, the aphis lion, who destroys aphids without pity.

It was in the fruiting raspberry patch that I acquired my first one for study. Always the patch yields much more than a July dessert. Wasps and stinkbugs are there to teach vigilance, one by prompt and the other by delayed action. But in general the insects of the patch are innocuous to man. They accumulate with the berries and enliven the sorting. When Nergal, up-to-date, not yet equipped with wings, appeared among them, I caged him to settle mooted points in his biography. Thereafter he and his kin taxed my time until late September.

Since numbers might ensure success, search began for more lions, and for the eggs of their mothers, the lacewing flies. Vegetation that harbored aphids was the hunting ground, since the lions would be found amidst their food. Two more lions and eggs a-plenty were bagged. Mother Lacewing, Careless, laid eggs on plant stems, or anywhere on leaves, even indulging in haphazard fringe; Mother Lacewing, Careful, left solitary eggs where prey was scarce and bristling clusters where it teemed. Fresh eggs were greenish, paling and then turning grayish as the embryo developed. Each was a wee ellipsoid at the tip of a stiff, three-eighths inch, silken stalk.



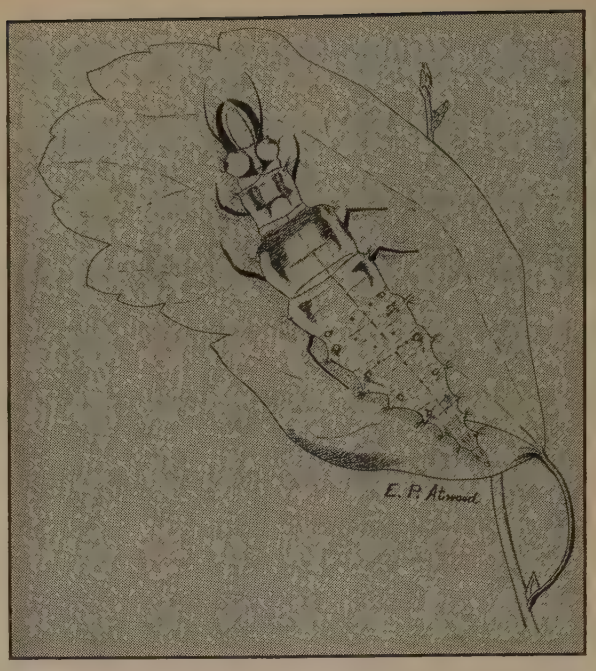
Hungry aphids on the stem of the bud and three lacewing eggs anchored to the leaf at right.

The egg-stalk is a safety device to prevent the first-born from eating the unhatched. Nature's distrust of her babies is justified, for one cub dined off a butterfly egg that I cherished. A year passed before I could replace it.

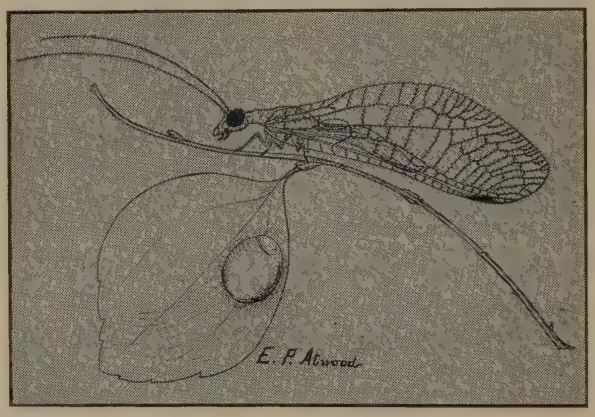
To *see* a Lion hatching is amazing luck, yet that good fortune was mine. The newborn was so tiny and of such pristine transparence that I could not have seen it, let alone mark its behavior, without a magnifying glass. Its

disproportionately large mandibles burlesqued its body. A row of concavely-graduated hairs bristled from mid-back to tail. The front hairs curved backward, the back ones forward. They vanished later in a molt and hairy tufts were spaced along its sides instead.

Now the descent of an egg-stalk has legendary, steeplejack risks. I kept dogged vigil to see the outcome. The little scamp clung to its shell, head-down, for a full half-hour with all the contrariness of a watched pot. It bent its supple tail hook-wise over the rim of the uncapped egg and took its ease while I came to a boil. To outsmart an insect should not be hard, but a half-hour of squinting through a strong lens can raise a lot of questions on profit and sanity. At last the pole-sitter stirred and I bubbled over in the delight of a discovery. Babe that it was, it knew its business. It edged forward guardedly until it could clamp the tip of that anchoring tail about the egg-stalk and then, in harmony with unhesitating footwork, it slid it along, just as a laundress slides a clothespin along a line. What a solution! What a flouting of traditional danger!



The larva was about three-eighths of an inch long when mature. From the cocoon on the leaf came the delicate lacewing fly, golden-eyed and with transparent green wings and green body.



When the wise infant reached the leaf, it was gently "canned" with aphis-infested spirea tips. Shortly it was less transparent. It throve until the fateful seventh day when I lost it on a rug of mixed color during transfer to a clean jar and fresh food. The mishap taught me to make other transfers over white paper. This lion was not duplicated in my menagerie. It had green markings where my other lions had dull red. All had cream-colored humps regimented along their sides, like pustules on parade.

Each of my lions had its own jar; for I was more interested in cocoons than in possible clashes. It developed that small aphids were attacked first. A lion seemed reluctant to take on prey near its own size, although it would maneuver and pounce from the rear finally. The victim was elevated. By gravity and suction aphis-wine flowed from its natural cask into that provided by the lion. Futile kicking may have accelerated the process. Nature wastes nothing. She merely revamps. Aphis-tipple became scarce. Lions had to be fed fourteen to seventeen days before, fat and humpbacked, they matured.

At length, as I fervidly wished, I found a lion in the early stages of cocoon making. The task was going on between two spirea leaves. One could be worked off. The rounded shell was still so flimsy that, with the lens, all was plain. The lion had rolled itself up like a jelly-roll. Its jelly-red markings added to the realism. It kept turning backward by short hitches; spinning, turning, and tightening; spinning, turning, and tightening. Its head moved from side to side and up and down while it spun furiously, as if desperately pressed for time. But I missed something. Puzzled, I scrutinized the insect and knew. *It had shed its mandibles!* Well, why not? Would they not foul in the silk and be a useless drag? Long after it was obscured by silk, the heave of its turning continued.

In exactly ten days the larva cut a lid from its cocoon, leaving a hinge. I found it outside and fully developed. This time its name was appropriate. It was a lacewing fly—dainty, golden-eyed, with transparent green wings and green body. It was almost as pale a green as the discarded pupa case.

Under the microscope normal cocoon silk looks like froth, but, among several cocoons, I soon possessed one that was very loosely woven. Its meshes contained globules that shone like quicksilver. In it I could see the pupa and the cast larval skin behind it. I could follow metamorphosis. The pupa's large eyes, proboscis, and antennae cases gleamed with the unreal reality of cellophane. As days passed this ghostly appearance took on mundane tan. Hatched, this lacewing was tan-colored and smaller than its commoner green kindred.

At one time I had four lacewings in a jar for three days. It has been stated that they live exclusively on aphids, but I found that they liked syrup—syrup from canned pears being that used. To my knowledge none of the lacewings had mated when I allowed them to flit off into the garden about their business.

Hobnobbing with lions and lacewings had been both instructive and amusing. Nature never bores.

". . . spread her small, gray wings, and settled herself there, a tiny but sufficient parasol of shade."

Father is coming, and in anticipation of the event four baby flycatcher mouths are ready and wide open.

Spying on the domestic affairs of rearing and feeding young fails to disturb this—

Flycatcher Family

Photographs by the Author

By JOHN LINDSEY BLACKFORD

SWIT! She introduced herself with a gentle explicative, and scarcely paused to inquire what I was doing fifteen feet up in the air, peering into her nursery. It was more important that the children be fed, and selecting one of the four wide, pleading mouths, Mrs. *Empidonax wrighti* popped into it a lacy-winged fly. Then she sidled around to the nearer edge of the nest, spread her small, gray wings, and settled herself there, a tiny but sufficient parasol of shade. Although just twenty inches away, I could only speculate upon her identity.

Her coloring was olive-gray above, lighter beneath, with a slight tinge of yellow. Together with whitish eye-ring and dull, whitish wing bars, these markings are common to several of the lesser flycatchers. More ornithological brows have been knit in the effort to identify members of the *Empidonax* group than in the case of almost any other North American birds. Yet they continue to puzzle experts—even when examined in the hand. To make identification certain, old acquaintances must often wait until Traill's flycatcher reaches his summer home amid the willows, until Hammond's voices his emphatic *seewick, seewick* from the montane firs, or for *griseus* to set up housekeeping upon the sage flats. So greatly do these small "gnat kings" resemble one another that location of nest, notes during breeding season, shading of egg coloration, range and habitat must all be assembled to assist in the solution.

My confiding little housewife had built her nest in a slender mountain maple stem, choosing for her surroundings a forest of mixed conifers and broadleafs. The cradle that held the four was fitted snugly into an upright, triple crotch. Woven chiefly of fine, weathered grasses, its numerous silvery strands hung loosely downward for twelve or fifteen inches. The innermost lining was composed of a few soft feathers. Had I not drawn nearby branches aside, the whole would have been well shaded by the cool leafage.

Twice, in the next quarter of an hour, movement on my part caused the little mother to leave her post, but duty soon recalled her. When the hot sun stole

There appears to be some discussion as to whose turn it is next to take over the responsibility of the young.

However, father flycatcher seems to know whose turn it is and precisely what is required under the circumstances.

behind a high fir bough, she immediately disappeared, dashing back, however, with a moth for the interrupted lunch.

During a week, while I trained my camera upon her fuzzy family, she never faltered in her task. Her mate, although generally in close attendance, did not risk an approach to the nest more than four or five times while I was there. The youngsters, first seen with their eyes barely open, grew rapidly until they bulged over the rim of their neat little bowl. If they suffered from the direct rays of the sun, striking down through parted branches, mother was there almost instantly to shield them. If they grew restless with hunger, she was gone no longer than the space required to snap up a passing fly. Then she was back with wings held over them, while she herself panted in the heat.

To record her shy mate as he brought additional fare, I was obliged to involve Mrs. *Wrighti* in several such trying ordeals. She never failed or flinched in her duties. Her utmost protests were just *pit!* or perhaps *quit!* Such devotion and patience are uncommon, even when the need of intrusion is better understood. Certainly we can pardon the flycatchers for the obscurity of their dress, when among them we find such faithful subjects for our inquiring camera lens.

★

Weeds

By DANIEL SMYTHE

They are not humble; the heads are placed
  Proudly erect with nettle, thorn—
Tearthumb, and sorrel with its sour taste,
  The ragweed peering through the corn.

Beyond the pasture walls one treads
  The gropers for the rain: burdocks,
Yarrow and silverweed, the heads
  Of catnip with its wiry stalks.

We cannot help but note the run
  Of weeds which earth has reared with pride.
Bull thistles thrust against the sun;
  They know they will not be denied.

Josephine Reinhardt, a Victory Gardener at the tender age of three and one-half, harvests this prize eighteen-ounce tomato from a Long Island garden.

Victory gardens provide thousands of youngsters an intimate contact with the soil and knowledge of growing things that they might otherwise not have known.

Youth in the Garden

By ANDREW S. WING

THE WAR has been difficult for many children. In many cases and in various ways it has caused maladjustments that can affect their lives and characters even more than adults are affected. Yet, in spite of obstacles, our youngsters have risen splendidly to the emergency, and in a myriad of activities. Among the outstanding examples of their resilience and resources are Victory Gardens.

One of the best gardens seen in a judging tour of a Long Island town last summer belonged to a lad not yet in his 'teens. It was well planned, the vegetables were flourishing, and the absence of weeds and insects was refreshingly noticeable. In fact, this boy's garden easily topped many of the adult gardens visited that day. The youthful owner was on hand to point out proudly the results of his season's work. A younger sister also had a lesser but still a very creditable garden. And this was a home-garden project with little or no supervision, except from the parents.

Inspiring reports and photographs have come from the larger and highly-organized children's garden projects in such widely distributed cities as Boston, New York, Cleveland, Chicago and Los Angeles—to name only a few. In most of these cities, gardening had been a part of the regular school curriculum for some years before the war. But the need for home-grown food enhanced the interest in gardens for children and accelerated a movement that has been surely but slowly gathering momentum for many years.

In many ways gardening fits ideally into a regular school program. Few parents are as well suited to be garden advisers or leaders as are trained teachers. Parental supervision too often resolves itself into the set formula of

There is a special thrill in the harvest of the products of one's own toil. At the left two of the youngsters are proud of the early radishes and onions that they grew in one of the plots maintained by the Cleveland Board of Education. At the right two other youthful gardeners prepare to take home a box full of the products of one of the gardens for school children provided by the Chicago Park District.

The Victory Garden program maintained for youngsters by the Chicago Park District begins with a parade.

"Johnny, you've just got to hoe the weeds in your garden today," or "Mary, run out and pick the tomatoes right away—I need them for supper." The garden thus becomes a family chore instead of a pleasant adventure into the world of plants. Under the right kind of adult guidance it should be such an adventure.

Gardening for children can be fun, even though it also involves hard work, discipline and requires a supervised routine. Success requires leadership of a high order, and usually it is better to have leaders experienced and trained in both gardening and in the handling of children. Whether in small or large groups, a definite system of organization is necessary for a successful garden program.

Children are instinctively interested in plant growth and the other processes of Nature. Indeed, who does not get a thrill every spring from watching the buds burst and seeing the little brown seed heads push through the ground? And when the first crops are harvested, the cup is full indeed. But unless the early enthusiasm can be sustained throughout the season, the garden will become a tangle of weeds and wormy plants, instead of a prolific food plot. To focus the active energy of a lively boy or girl on the serious business of weeding, thinning, cultivating and bug killing for a period of three or more months is no mean task, but it can and is being done in hundreds of communities every season.

The first problem to solve is that of providing an incentive for the youthful gardeners. They must be made to feel that the garden is their own personal enterprise. Simple awards or prizes will stimulate and help sustain interest. Ribbons, certificates, medals, or inexpensive plaques will serve just as well as more expensive awards. A few more substantial awards, such as War Bonds, may be used for top prizes, if funds are available. Often these will be willingly provided by business firms or interested individuals. The spirit of competition is keen in children, and it is easy to arouse a strange but friendly rivalry in community or group garden projects.

The plots may be located either at school grounds, in parks, or in other fertile vacant land suitable for garden purposes. These projects should be convenient to the homes of the children. Paul R. Young, Garden Supervisor of the Cleveland School Board and one of the ablest leaders in the school garden movement, is a strong advocate of supervised home gardens. These home gardens, he insists, must be visited at regular and frequent intervals by trained garden leaders. In Cleveland, where many thousand school children have gardens every year, there are both community plots located on school grounds, and home gardens, but the latter predominate.

In larger and more congested cities such as New York and Chicago, it is often necessary to provide community plots for the children. New York City had 138,573 junior home gardens in 1943, under the veteran school garden supervisor, Marvin Brooks. It requires thousands of trained garden leaders to provide the personal guidance needed in these large school systems. Science teachers often serve, and make good garden instructors. Indeed, gardening is one of the best methods of teaching

The City of Boston offered a plot in Jamaica Plain and four boys asked for it. They brought in a record crop.

Jack Collins and Dick Outhwaite are too busy tilling the Victory Garden plot in the Niagara Power Company's gardens to stop to pose for their picture.

some of the fundamentals of the natural sciences.

Chicago turned over enough park land for 14,000 children's Victory Gardens last season. This was one of the finest examples of junior wartime gardening. Notable projects have been carried on in other large cities, as well as in smaller communities.

Fine garden work has also been done by such organizations as Boy Scouts, Girl Scouts, Campfire Girls, and by local clubs and other groups. The latest development is the conducting of state-wide contests in such states as Illinois and Michigan. There is serious consideration being given to the setting up of a new national club of boys and girls to do for town and city children what the famous 4H Clubs do for farm children. The 4H Clubs have provided garden projects for farm girls and boys for many years, with notable results. Hundreds of thousands of farm youngsters cultivated their own Victory Gardens last year, and are carrying on in this splendid war effort again this year.

The size of a garden for a child should be large enough to occupy a good share of his time and energy without becoming an irksome chore. The school garden plots are usually not larger than eight by ten feet, but home gardens may be somewhat larger, depending on the land available and the age, energy and ability of the child. These small plots, if well tended, have demonstrated that goodly amounts of vegetables and some flowers can be provided for the family table from a child's garden. In the schools, emphasis is placed on the educational value of gardening, but the value of the crop for home use is not neglected. It is one school project where the child actually has something tangible to show for his season's work.

In the school gardens, tools are usually provided and plowing is done for the group before the plots are staked out. A nominal charge is usually made for seeds and fertilizer. There is a company that specializes in supplying small packets of seed in collections suited for school garden use. Each plot has a uniform plan, which makes instruction and supervision easier. Many of these children's gardens would put to shame the efforts of their elders in the neatness of their plots as well as the excellence of the vegetables grown.

On New York City's East Side is located one of the finest groups of children's gardens one can see anywhere. Sponsored by the New York Plant and Flower Guild and located on land belonging to the Rockefeller Institution, this project has been going long enough so that near perfection is achieved. Many of the children here start when quite young and carry on up into their early 'teens. Quite a number are of foreign extraction, sons and daughters of East Side workmen or mechanics. It is an inspiring sight, indeed, to visit this garden during the growing season and to see the excellence of the work and the extreme tidiness of the entire grounds. Here, under the skillful guidance of Miss Miller, a high degree of skill is attained. Last autumn, when children from this group were invited to compete with skilled amateurs and professionals at the New York Horticultural Society's Show, they carried off a number of prizes for both displays of vegetables and flower arrangements.

Another splendid children's garden is sponsored by the Brooklyn Botanic Garden. Here a skilled group of instructors work under the direction of Miss Ellen Eddy Shaw to teach city youngsters the fundamentals of vegetable growing and plant life. One would be indifferent indeed not to be moved by the work that is being done in any of the outstanding children's garden projects. These youngsters will be our top gardeners of tomorrow, and better men and women for the training they have had in this interesting field.

That garden education has a direct influence in helping to check juvenile delinquency has been demonstrated in a number of important cities. What to do with the children is a most serious problem when both parents are engaged in war work. Idleness leads to boredom, and it is only a step from boredom to mischief. Supervised work or play is the best preventive of juvenile peccadillos, which, if unchecked, may lead on to actual crimes of violence, thievery or immorality. Girls in their early 'teens have proved a troublesome group in troop concentration centers or war-boom towns. Child experts and crime prevention officials are giving serious attention to this problem. It has been definitely found that one of the best activities to keep the young interested and occupied, when their parents are unable to give them proper attention, is a supervised garden program.

In a certain tough neighborhood in a poorer part of Boston a boy's gang was (Continued on page 331)

9 P.M., June 1; 8 P.M., June 15.

9 P.M., July 1; 8 P.M., June 15.

To use these maps hold them before you in a vertical position and turn until the direction of the compass that you wish to face is at the bottom. Then, below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens. It will not be necessary to turn the map if the direction faced is south. Time given is Standard Time; add one hour for War Time.

June-July Skies

By ISABEL M. LEWIS

VENUS has been for many months a brilliant Morning Star, but this reign of splendor is now ending as the planet slowly draws in toward the sun. It disappears from view completely near the date of its superior conjunction with the sun on June 26. It will next be seen in the evening sky in July, but will not be well placed for observation during that month, since it will be close to the horizon at sunset. It will be interesting to note how near to the time of conjunction one can continue to see Venus near the eastern horizon before sunrise, and how soon its appearance above the western horizon after sunset can be detected in July.

Two other planets besides Venus are due to disappear in the sun's rays, and to come into conjunction with it during this two-month period. Mercury is in the morning sky at the beginning of June, just past its western elongation, but only a few degrees above the eastern horizon at sunrise. It draws closer to the sun during the month and is in superior conjunction with it on July 1, passing then into the evening sky. As brilliant as Vega, it may be glimpsed in the evening twilight by the end of the month, a few degrees above the northwestern horizon. Saturn, which has been a beautiful object for so long in the evening sky in Taurus, is too near the sun to be well observed in June, and it will be in conjunction with the sun on June 21. It will pass to the morning sky at that time, and by the middle of July should be visible low in the east, before sunrise, in the constellation of Gemini.

Jupiter will be in the western sky during these two months appearing low in the evening twilight by the end of July, and setting then less than two hours after the sun. Mars and Jupiter are both in Leo during this period. Early in July Mars will pass close to Jupiter, and on July 10 will pass within less than one degree of the first magnitude star Regulus in Leo. It will be interesting to watch the changing positions of these two planets with respect to each other and the bright star Regulus during the early part of July. By the end of that month Mars will be too close to the sun to be seen to advantage. Jupiter will be in conjunction with the planet Mercury on July 29. This will be an excellent time to find Mercury with the aid of binoculars, since Jupiter will be easily observable because of its great brilliancy, and Mercury cannot be far from it near the time of conjunction. Mercury itself, although much inferior to Jupiter in brightness, will be then brighter than a first

magnitude star and interesting to the sky observer.

The sun will be farthest north of the equator on June 21 at 8:03 A.M., Eastern Standard Time, when summer will begin in the northern hemisphere and the day will be longest. The sun changes its position in declination very slowly at this point in its orbit, and, for this reason, the length of the day and time of sunrise and sunset will change little for two or three weeks. Two thousand years ago, when the sun was in the constellation of Cancer, The Crab, at this season, the slow, crawling backward motion of the creature was said to typify the slow motion of the sun when in this position and its change of direction, backward toward the equator.

There is to be an annular eclipse of the sun on July 19-20, Eastern Time, which will be visible in its partial phases over central and eastern Africa; central, and eastern Asia; the southern part of Japan; The Philippines; the East Indies; Australia, and islands of the western Pacific. The path of the annular phase of this eclipse, within which at the time of greatest eclipse the moon will be seen to completely cover the sun except for a thin ring, or annulus, of light, will extend from the eastern part of equatorial Africa to a point in the Solomon Islands near Bougainville. It will pass over Poona in India and south of Calcutta; close to Akyab in Burma; over Thailand, Catabato and Davao on Mindanao in the Philippines; grazing the northern coast of New Guinea, near Wewak and Madang, and passing over the part of New Britain and other islands in this vicinity. The annular phase of this eclipse along the central line of the path will last from three to three and a half minutes. It should be visible to many on sea and land and in the air in this war zone region. In India the middle of the eclipse will occur in midday, and in northern Australia and the islands north of there late in the afternoon or at sunset.

Meteors belonging to various swarms begin to appear in greater or less numbers before the end of July, forerunners of those that are to appear in large numbers during the following month. Some of them are slow-moving and appear in the early evening or near midnight, while others, darting swiftly across the sky at later hours, belong to other swarms and come from radiants located in a different part of the sky. It is interesting to note how different in color, speed and other characteristics are these members of different swarms. One should not expect to see meteors on a moonlit night, but, when the moon is below the horizon, it will be noticed that there is scarcely an evening at this time of year that one may not see several meteors, belonging to different swarms, in the course of an hour of watching the heavens.

A characteristic configuration of late spring and early summer is now conspicuous in the western evening sky. It is the large equal-sided triangle formed by the first magnitude stars Spica, in Virgo, which is a white star, Arcturus in Bootes, orange-colored, and the second magnitude star Denebola at the end of the tail of Leo. Corona Borealis, The Northern Crown, is a beautiful little circlet of stars now to be seen between Bootes and Hercules, and beyond Hercules is the brilliant Vega with two little fourth magnitude stars forming a small triangle with it. Red Antares is now brilliant in the southern sky.

The Sky's Murals

By MARGARET S. HOSMER

What artist planned star-patterns on the sky
In storied constellations wide unrolled,
Where queens and heroes hold their places high
In pageantry of purple and of gold?

Andromeda, pinned fast against a star,
Brave Perseus rescues with the baleful beam
Of dread Medusa's eye that routs afar
The monster Cetus. Through the midnight, gleam

The blue Harp-star above the white Swan spread
For flight; a queen's Crown; and the astral Bear
Between the Dragon's coil of silver thread
And the gold shine of Berenice's hair.

But stars cease not to travel. Later hours
Paint other legend outlines on the night.
They are arranged like garden-beds of flowers,
And the still world admires the glittering sight.

★

Captive

By HELEN MITCHEL

Far in the silver west, tranquil and cool,
Venus is held like a luminous jewel
Drawn from the shadows by evening spun,
And bound through the ages to follow the sun.
Voices of twilight all tremble and sigh
As the radiant captive is led from the sky.

The School Page

By E. LAURENCE PALMER

Professor of Rural Education, Cornell University, and Director of Nature Education, The American Nature Association

AMPHIBIA IN SCHOOL AND OUT

When, in the spring, the average teacher wishes to do something practical in Nature study, the chances are good that some pussy willows will appear on the desk, and a jar with some "frog's eggs" sit on the window-sill. Soon, the pussy willows are in the waste basket. Not much later, the eggs hatch or are thrown out. If they hatch, some day someone will surely propose that the lot of the tadpoles would be improved if they were put in a clean jar with clean water. If this is done, the tadpoles probably soon follow the pussy willows.

Really, though, the study of the development of the young of many amphibia offers excellent lessons in the art of living. Living things must have food to continue to exist, and when young growing tadpoles are put into clean water, in clean jars, they have nothing to eat. Therefore, they die. Were they left in the jar, where there might be a covering of ooze and slime, this seemingly offensive stuff might well sustain the little animals. In fact, one of the roles of the slime would be maintaining tadpoles, or one of the roles of tadpoles that of cleaning the slimes away from the region in which they live. Better still, we might recognize what is really the case—that the slimes and the tadpoles seem to get along well together.

It is probable that amphibia that are dead are studied more commonly in schools than are those that are living. Certainly, they are studied under unnatural conditions. It is estimated that about 500,000 frogs are used each year in the school laboratories of the United States. Some place this figure much higher. The eggs of amphibia are commonly studied—particularly in their earlier stages—to show how cells divide. Under natural conditions, it would be fortunate indeed if fresh eggs could be made available to any considerable number of school laboratories. However, the laboratory scientists have learned tricks whereby many kinds of amphibia may be induced to breed and to produce eggs in almost any month of the year.

Breeding Amphibia

Artificial stimulation of breeding is usually brought about by adding certain glandular materials to the living animals and then letting the breeding take place. With the common leopard frog, the pituitary glands are removed from six female frogs. The contents of these glands are injected with a hypodermic needle into the body cavities of three males and of three females. Mating usually follows and egg-laying may result.

In the case of the vermilion-spotted newt, breeding has been stimulated by keeping the prospective mating animals in cold water for about two weeks. They are then placed suddenly in water at a temperature of about 72° F. The females are then fed finely-shredded beef pituitary glands, and normal mating may be expected within a few days. The beef glands may be frozen fresh and may be used when they are thawed out.

The Mexican axolotl, in which the breeding animals appear like the larvae of many salamanders, may be made to breed by keeping them in cold water for some days, and then suddenly raising the temperature to about 65° F.

If one wishes to use eggs that have been laid normally in the field, it should be known that with the leopard frog the egg mass, when freshly laid, has a pale bluish jelly. Such egg masses found in the pools in spring in early morning should show at least two or three cleavages by afternoon, although this may be delayed by keeping the temperature down.

Some species of frogs will be found to breed and lay eggs the first night after a rain following a dry period. Others do not lay their eggs until the second night, while still others more rarely delay the act until the third or the fourth night.

Those who collect frogs or their eggs for use in laboratories should use judgment and not exhaust the population of an area. A single egg mass of a leopard frog should provide enough tadpoles to populate a six-gallon aquarium. Unless there is a real need, then, few schools should find it necessary to collect more than one such mass in a season.

Frog Most Popular

It is possible that the frog is the most popular laboratory animal in America. Properly prepared frogs for use in the laboratories may be purchased from the supply houses for around a dollar a dozen, although the larger animals may bring a dollar apiece. Chilled egg-masses may sometimes be had from the supply houses at the rate of about two dollars for about two hundred eggs. Schools that wish to experiment with artificial stimulation of breeding may buy both the animals and the stimulating glandular material from the supply houses.

Obviously, there should be more profit in raising and preparing these animals for sale as laboratory specimens than in using them for food. The wholesale prices are highest from February to March, and most of the laboratory animals used in America probably come from such states as Minnesota, Wisconsin, Illinois, Iowa, New York, Pennsylvania and New Jersey.

So great has been the drain on the frog populations, for food or laboratory study, that the source has been protected by legislation in many places. Laws designed to protect frogs—either in the breeding season or at other times—have been on the books of Delaware, Idaho, Louisiana, Maine, Michigan, Minnesota, Nebraska, New York, North Dakota, Pennsylvania, South Dakota, Washington, West Virginia and Wisconsin. In most cases, these laws are directed against unreasonable methods of trapping the animals in their migrations, either to hibernation or to or from the breeding areas. In some places, frogs have been known to hibernate in great masses, and one record tells us that 300 pounds of frogs were once found in one mass.

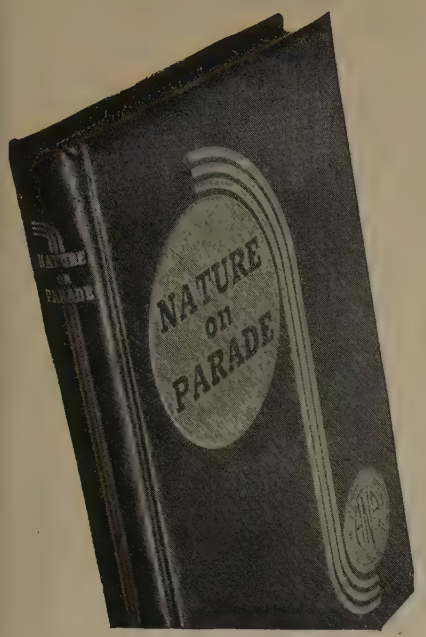
Amphibia in Demand

Amphibia are in demand in biological laboratories for many reasons. The liver tissue of *Amphiuma* yields exceptionally large cells with large nuclei. *Necturus* is probably the most popular tissue-yielding amphibian for the laboratories, and *Cryptobranchus* is next. It happens that the animal that is usually most popular is the one on which there is most satisfactory supplementary text material, the assumption being that if what the student finds in the animal is not like what is found in the book then the animal must be wrong.

To many, the great interest in amphibia indoors lies in maintaining them alive and happy in aquaria or terraria. The little red newt or eft is one of the most popular of these. One record shows us how one of these animals was kept in a terrarium for seven years and that it did not change to the normal water form. This particular animal used to eat regularly about once a week, and would make its hunger known by its actions at weekly intervals. Once it had been fed, it would retire to seclusion. It fed at these times on small pieces of beef, earthworm and other animal matter offered to it on the point of a toothpick.

Most captive adult amphibia may be fed on almost any small form of animal life. The commonest stock food for such animals is the meal worm, if the animals are being kept in great numbers. Individual animals kept in small areas may learn to eat meat taken from a toothpick, or suspended at the unknotted end of a thread and moved in front of the head.

Every year as the spring season comes around, the zoology department of Cornell University asks me to bring in to them any newts I may find on my regular field trips. They wish to



NATURE on PARADE

An album of more than one thousand of the finest Nature Photographs ever taken

Only $5.00 *postpaid*

A beautiful book, size 9 x 12, 388 pages, bound in dark green imitation leather, Spanish grain, soft padded cover, stamped in gold leaf.

Since NATURE MAGAZINE made its bow in January, 1923, thousands of Nature pictures have been reproduced on its pages. These constitute the most remarkable pictorial parade of Nature ever published. The editors of NATURE MAGAZINE have reached out to gather together the best in Nature pictorial features, presenting them through the graphic process of rotogravure. More than one thousand outstanding Nature pictures are presented, with descriptive story relating to them. They unfold the camera's record of the life history of birds, mammals, or insects; or they represent typical flowers, trees, and other Nature forms of a certain region. A book of surpassing beauty and constant interest.

The edition is limited to one thousand numbered copies

Mail your order today

American Nature Association
1214 Sixteenth St., N. W., Washington 6, D. C.

Enclosed find $_____ for _____ numbered copies of NATURE ON PARADE.

Name _____

St. & No. _____

City & State _____

use them to show students *Trypanosoma*, a common blood parasite, or some of its relatives. Amphibia might also yield to these zoologists *Gerardia lamblia*, an intestinal flagellate; *Pneumoneces*, a lung fluke; or *Lankestrella rananum*, a sporozoan blood parasite. However, one can look at all of these parasites, at the marvelous somatic mitosis to be seen in the large cells of the tails of the tadpoles of the tiger salamander, *Ambystoma tigrinum*, and still miss completely the satisfaction that goes with knowing the amphibia better. The elementary school children of Florida who are asked by their state science program to clip the tails of tadpoles to observe the regenerative process are missing the thrill of seeing a salamander stalk in early morning through the wet moss, or the humor to be found in observing a toad take the last mouthful of his newly-shed skin. As for me, if I want satisfaction in my experiences with the amphibia, give me the opportunity of seeing any of them healthy and sound in their natural environment.

Bison Killed

Although it may seem strange to many that we could have more bison that can be maintained, the National Park Service found itself confronted with that situation with the Lamar bison herd in Yellowstone National Park. There were more animals than the range could stand, and four hundred bison had to be eliminated. The Service had hoped to dispose of a substantial number by live shipment to preserves or zoological parks, but was able to salvage only three animals that way. The remainder were baited into corrals and shot by Service employees, while the skinning and quartering was done under contract. The meat and hides went to sixteen Indian agencies, and more than a ton of fat was salvaged. Studies are now being made to handle the smaller herd without the necessity of winter feeding on hay.

Musical Butterfly

Verne R. Holmes of Los Angeles, California, is a butterfly collector and often nets some extra specimens to observe alive. We quote from a recent letter: "On one occasion I let a few loose in my room, and one of them, a *Pieris rapae* (cabbage butterfly), landed on the back of my hand while I was reading. A moment before, I had turned on the radio and it was playing a beautiful Viennese waltz. At once the butterfly began tapping its right front foot in perfect rhythm with the waltz. The brilliant performance continued until the conclusion of the music, then this tiny artist backed off my hand and flew to the other side of the room. Could this have been a butterfly with musical talent, or a mere coincidence? I do not know, but it shall ever remain my favorite musical performance."

Free Catalog
Just Off the Press!

Fully illustrated, showing special footwear and clothing for fishermen and campers, also special fishing tackle.

L. L. Bean, Inc.
Freeport 77, Maine
Mfrs. Fishing and Camping Specialties

NATURE LOVERS' LIBRARY

Six Giant volumes, 8½ x 11⅛, 2,000 pages, weight 23 pounds. Lives and habits of 3,000 species of birds, mammals, reptiles and fishes described by world famous Naturalists; 1,000 species illustrated, 300 in natural colors; published at $29.50. The Literary Mart, 411 West 125th St., New York, offers this set to members for $19.50, returnable for full refund after 5 days' examination. Nature Encyclopedia edited by G. C. Fisher, 5 volumes with 200 colored illustrations, given free on orders mailed promptly.

TROPICAL FISH

You can have a small section of the South Seas right in your home . . . richly colored tropical fish . . . exotic in shape . . . swiftly darting among the undersea foliage. 60 page catalog. ALL FISH IN FULL COLOR PLATE. 10c coin or stamps. 25c Foreign Country.
Dept. N, Eastern Gardens
Kissena Blvd. & Rose Ave., Flushing, N. Y.

THE TEN-YEAR INDEX
(Volumes One to Twenty)
makes Nature Magazine a textbook. Order yours now . . . 50c

Monastery Secrets

. . . THE FORBIDDEN KNOWLEDGE OF TIBET

What strange secrets of nature are locked within the mountain fastness of Tibet? What control over the forces of the Universe do these cloistered sages exercise? For centuries the world has sought to know the source of their power—to learn *their mastery of life*, and *their faculty for overcoming problems* with which the masses of mankind still struggle. Have they selfishly deprived humanity of these rare teachings?

WRITE FOR THIS FREE BOOK

Like the streams that trickle from the Himalayan heights to the plateaus below, *the great truths* of these brotherhoods have descended through the ages. One of the preservers of the wisdom of the Orient is the Rosicrucian Brotherhood (not a religious organization). They *invite you* to write today for their FREE Sealed Book, with its amazing revelations about these mysteries of life. Address:
Scribe I.L.E.

The **ROSICRUCIANS**
AMORC
San Jose, Calif.
U. S. A.

JEPSONIA SAVES FOR A DRY TIME

By E. YALE DAWSON

A warm, dry day in early December had come to the Del Mar hills, and as yet only rain enough to put a thin crust on the adobe dust of the roadsides. On the mesa back of the high line of bluffs dropping into the Pacific, a road runner scurried along a brush-bordered path and darted into a thicket of cactus. A little to the north, barren patches of yellow sandstone shone brightly from the eroding canyon slopes. Along the path the wild buckwheat had turned deep brown. The rock cabbages were withered and wrapped in dry leaves. Chollas poked up here and there through the lifeless, brown clumps of brush. Prickly pears were thin and withered, the "veins" showing through emaciated pads. Over everything there lay a thin coating of powdery dust, blown by warm winds from the even drier interior. There was ash, too, from brush fires still burning in the foothills.

Walking along the edge of the mesa where it drops off into a canyon running down to the sea, I stooped to pick up a stone and saw, arising from the brick-hard, kiln-dry adobe, a tiny, white flower on a slender, leafless stem. I excavated to determine the source of moisture and energy for so delicate a structure in such a forbidding environment, and found a small corm-like root organ, withered and shriveled as if the last atom of substance had been withdrawn to supply the needs of the minute inflorescence. It was a remarkable exhibition of the transfer of stored energy, allowing the plant to fulfill its destiny to bloom even under the most adverse conditions.

Jepsonia parryi, of the Saxifrage Family, inhabits the foothill country of southern California between San Diego and San Jacinto Valley, and is one of the few plants adapted to take advantage of the earliest fall rains in coming immediately into flower. The leaves do not appear until after the flowering shoot has completed its functions. Then they expand and build up food reserves to be stored in the fleshy root through the long dry season. On the occasion related here, the plants had received the seasonal stimulus for flowering (the trace of moisture from the scant shower, or perhaps the cooling nights of late November) and had set out to bloom in spite of the absence of anticipated rain. Lacking fresh water supplies, they had drawn upon carefully guarded reserves, and on the very threshold of complete desiccation had fulfilled their obligation to the survival of the species.

Dr. Shantz Retires

Dr. Homer L. Shantz, since 1936 head of the Division of Wildlife Management of the U. S. Forest Service, has retired from active duty. Born in Kent County, Michigan, in 1876, he has had a long career as naturalist and educator. Teacher and professor of zoology and botany, he taught at Colorado College, the Universities of Nebraska, Missouri, Louisiana and Illinois and served as president of the University of Arizona. He was widely travelled and a specialist on African plants, many of which he introduced into the United States as a contribution to American agriculture. Dr. Shantz will devote himself to writing and photography. His successor will be Lloyd W. Swift, a member of the Forest Service since 1928.

No Points Needed

There is much culinary emphasis in recent releases of the United States Fish and Wildlife Service. One of these announces that a limited number of copies of a leaflet entitled *Wartime Fish Cookery* are available from the Service, Chicago 54, Illinois. This is a brief cookbook and includes recipes for the use of fishes hitherto overlooked. Another release extols the merits of raccoon as point-free meat, pointing out that in 1942 trappers and hunters took 401,316 raccoons, figured to be the equivalent of nearly three and one-half million pounds of dressed meat. This information is supplemented by recipes for preparing roast raccoon with raisin nut stuffing and spiced roast raccoon. For our part we will leave *our* raccoons in the woods, but we hope that those who kill or trap them will not waste the meat. Still another release offers a leaflet on *Recipes for Cooking Muskrat Meat*, and a fourth records an increase in the consumption of freshwater turtles in "soups, stews and other savory dishes." If this keeps up there will be a move for a merger of the Fish and Wildlife Service with the Bureau of Home Economics.

Correspond

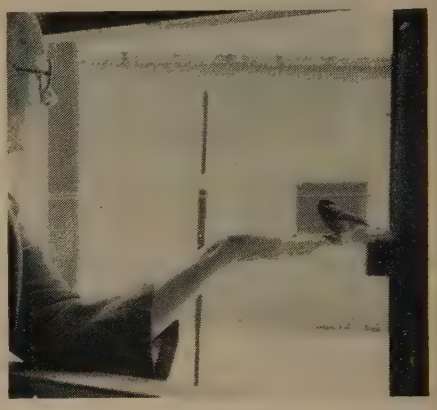
Leland White, Route No. 1, Bonne Terre, Missouri, is interested in Nature and would like to correspond with other high school students having a like interest.

BIRD MEMORY

By GRACE FRANKHAUSER

When Jack Frost takes the flowers, the petunia box outside the south kitchen window is quickly transformed into a winter feeding station for the birds. My work table is just inside this window, making it easy to keep them well supplied with food and warm water, and to watch them as they come and go.

We have cardinals, song sparrows, downy woodpeckers, chickadees, nuthatches, titmice and, of course, English sparrows, with an occasional uninvited jay or starling. Last season an extra early



robin accepted our hospitality for a few weeks.

As I watch the birds, they also watch me and soon accept me as their friend. A few individuals become tame enough to perch on my hand. One winter I had two such pets—a friendly titmouse that I named "Toppy," and a rather solemn-looking black-capped chickadee I called "Roundhead." They were soon vying with each other in taking food from my hand. If I sat by the window reading or sewing, one or the other would generally be fluttering around outside waiting for the window to open. I was never quite sure if it was the attention they received, or the tiny morsel of food I offered, that intrigued them. It could hardly have been the latter since there was always plenty of food ready for the taking. When spring came these birds left for parts unknown, the feed board was removed and the box filled with flowers and vines.

Looking out the north window one morning in late September, I noticed a pair of titmice daintily investigating a small piece of suet I had provided in anticipation of the return to Ohio of my winter bird neighbors. When I called softly, "Hello there, Toppy," I was surprised to see one of them look my way and immediately fly to the south window. When I opened the window the bird came to me at once, touching my hand. The following day it was perching on my hand with confidence, after, I am sure, a four months' absence.

THE FUNGI AND THE WAR

(Continued from page 294)

erties of the chance-born spore that spoiled Fleming's staphylococcus plate. Interesting possibilities, nevertheless, are developing through continued work on penicillin and other fungi. At the University of Pennsylvania, Dr. Walter Kocholaty finds in *Penicillium notatum* a new substance, penatin, which, he reports, stops growth of some 50 bacterial kinds in dilution of one part in 10,000,000. This is greater range, and greater power, than claimed for penicillin. Animal experiments suggest that penatin is relatively nontoxic. Reports of further study of this substance should be of great interest. From another *Penicillium*, British scientists produced patulin, later found to be identical with clavacin, reported from New Jersey in an *Aspergillus*. Early reports of patulin, as used in the British Navy, suggested its value in the common cold.

Gallup pollsters estimated that 13,000,000 American people sniffled from the pestiferous cold-virus in one fortnight in 1941. Anyone with a real cold knocker-outer could write his name in history with Fleming, parent of penicillin, and Domagk, discoverer of drug-use of the sulfas. American work on patulin as a cold-killer, although not extensive, has been less encouraging. So, unless the fungi can produce something better, we may have to keep on going to bed at the first sneeze. From the University of California, shortly after Pearl Harbor, came a report that a plant pathologist of Japanese extraction, Dr. William Takahashi, had found something in yeast that stopped a virus disease in plants. With the yeasts, it would seem, one never knows what to expect. They keep on working—and so do the scientists. Scientists of many nations have contributed to our knowledge of fungi both in peace and war. Their contributions will not cease when the war is over and our applications of them can be more fully constructive.

Vitamin A Shortage

Soupfin sharks are the chief source of Vitamin A for the United States, and the supply is being rapidly depleted, according to the U. S. Fish and Wildlife Service. It is from the livers of the fishes that the vitamin comes, and the recent emphasis on vitamins has spurred the fishery of the soupfin tremendously. No fishery, it is said, has ever increased with such rapidity, and continuance at the present rate would result in the early depletion of the shark population of the West Coast waters. Found over the continental shelf, which is narrow on the West Coast, there is a definite limit to the area in which the soupfin shark can live. Conferences have already been held to determine remedial regulations.

CLASSIFIED ADVERTISING

Biological Publications

Fifty years accumulation, hundreds of pamphlets and books, scientific and popular, in all branches. Smithsonian, Biological Survey, National and other museums, states, societies. Periodicals. Books on travel, exploration, hunting and nature in many lands. Send for pricelists, mentioning subjects.

J. ALDEN LORING, OWEGO, N. Y.

BUTTERFLIES

Watch this space for Specials in Tropical Butterflies from PERU, BRAZIL, COLOMBIA, MEXICO, INDIA, AFRICA, CELEBESE, NEW GUIANA, etc. BUY BONDS

Butterfly World Supply House
297 East 98th St., Brooklyn, N. Y.

FILMS DEVELOPED

IMMEDIATE SERVICE! Pictures returned same day order received. Smashing LOW Pre-War prices! Sixteen guaranteed Deckled-Edge Velox prints from roll, 25c. Or one colored or two plain enlargements FREE with 8 Deckled-Edge prints, 25c. 16 reprints from negatives, 25c. CANDID ROLL developed, Magic-Eye timed, vaporated, and enlarged to 3x4 on Deckled-Edge Velox Paper —36 exp. 35mm, $1.00; 18 exp. 60c; 16 exp. No. 127, 50c; 8 exp. Bantam, 25c. Reprints, 3x4, 3c each. We have new, perfect 35mm film! Low prices. FREE Mailers, details on request. **AMERICAN STUDIOS, Dept. NM-1, LACROSSE, WIS.**

HORTICULTURAL

10 **Rare, Novelty Cacti and Succulents $1.00** postpaid. **Coover's, Orlando, Florida.**

HARDY CHRYSANTHEMUMS — All leading varieties—strong field-grown plants. 12 gorgeous varieties labeled, $1.25—15 unlabeled, $1.25—list. **Farnam's Chrysanthemum Farm, New Blaine, Ark.**

INDIAN CURIOS

25 **Genuine Indian** arrowheads. $1.00. Catalog. **GEO. HOLDER, Glenwood, Ark.**

Medical Technicians

Medical Laboratory Technicians in great demand. We train you in your own home, in your spare time. Bulletin free. **Imperial Technical Institute, Box 973-C, Austin 5, Texas.**

MINERALS

"SERMONS in stones." Arizona rare minerals. Collectors or museum grade, 12 miniatures, assorted, colorful, brilliant, genuinely rare, $3. **Sam Parker, 2160 East Van Buren, Phoenix, Arizona.**

OZARKS

RAYBURN'S OZARK GUIDE, Lonsdale, Ark. Magazine for homeseekers, naturalists, sportsmen, folklorists. Year, $1.00

SEA SHELLS

FOSSILS for beginners and advanced collectors **CARRIE B. WILLIAMS, Clarksville, Ohio.**

SHELLS FOR SALE Land and Marine; Cape Cod Special 12 for $1.00 in box; Lists on request. **MRS. F. K. HADLEY, Box 33, West Newton, Mass.**

WRITING

SELL IN THREE MONTHS OR MONEY BACK

If you can write correct English—You can write Juveniles. In the past three years I have sold some 3000-3500 stories . . . articles . . . serials . . . series. Now, I'm teaching it.

Write for terms to
WILL HERMAN
Author of "My Juvenile Success Secrets" and "My Formula for Fiction."
Sanford, Fla.

COOKERY

in Camp and on the Trail

If you are a hiker, camper or motor camper you will value this compilation of sources of information and supply on camp cookery books and pamphlets; recipe literature; specialty foods for campers; hot and cold concentrated beverages; cook stoves and accessories; cooking utensils; fire-making devices; fuel tools; portable refrigerators and accessories.

Ten Cents, Postpaid

Send Your Order to
AMERICAN NATURE ASSOCIATION
1214 16th Street, N. W. Washington 6, D. C.

still $2.50
for a fine single room with bath
$3.50 to $7.00 Double
1000 ROOMS · 1000 BATHS
Write for Maps and Booklet
Prince George Hotel 14 East 28th St New York, N.Y.
George H. Newton — Manager

TEACHERS, WE NEED YOU

For Good Paying Positions Throughout the West. Best salaries are paid in California, Washington, Oregon, Nevada, Arizona. Grades up to $2000, High School up to $2500.
Unexcelled Service
FREE Registration

THE ROCKY MOUNTAIN TEACHER'S AGENCY
William Ruffer, Ph.D., Mgr.
410 U. S. National Bank Building, DENVER, COLO.
LARGEST, MOST WIDELY PATRONIZED AGENCY IN THE WEST

THE BROWN BOOBY IN HAWAII

By GEORGE C. MUNRO

Photographs by Arthur R. Tyler

There are three species of boobies frequenting the waters surrounding the Hawaiian group. These are the tropical representatives of the gannets of colder regions. The common or brown booby, *Sula leucogaster plotus,* is the wildest and least easy of approach on the nesting islands, consequently the collector has generally to shoot the specimens he requires, whereas the others can be caught by hand. The bird-bander also finds it easier to band young birds that have not yet left the nesting site than mature specimens. Yet this bird under certain conditions quickly becomes very tame. As its name indicates the brown booby is considered a stupid bird, but it has a considerable amount of good sense.

On the defensive.

Barbed wire entanglements are a now common sight about Honolulu and along the coasts of Oahu, Territory of Hawaii. On a morning early in July, 1943, someone called the attention of Dick Towill to a strange object on the wire about 100 yards out in the water in front of the house. He waded out to investigate and found it was a young brown booby. It was sitting on the wire with one wing hanging helpless. It probably had been injured by one of the frigate birds, which attack the boobies to make them disgorge their prey. When the boy approached, it dropped into the water and tried to escape. It slapped the water with its feet, the habit of these birds on rising, and waved its one good wing, but it could not rise from the water or go straight ahead. Dick caught it by the tail and towed it ashore despite its raucous squawking and attempts to bite. A bag over its head made it safe to handle, and it was deposited in the boathouse and shut up in the dark for a few hours. When taken out and placed on a perch about a foot from the ground the bird seemed to realize that no harm was meant and made no further attempt to bite or escape. It did not resent being touched and stroked with a stick, and before evening the boy could stroke its head with his hand.

The old boobies do not give food to the young—they open their beaks and the young thrust their heads down the old birds' throats to obtain the partly-digested fish. Dick procured some shrimps, pried open the bird's mouth and dropped them into its gullet. It swallowed them and thereafter was fed pieces of fish several times daily, shaking its head to get them down. Eventually it was necessary only to take its upper mandible between the finger and thumb with the little finger on the lower, and its mouth opened easily, but it could be fed in no other way. It became very tame. When taken off its perch to be fed it always returned to it. If the stick was left on the grass it sat on it there. If put back in its place the bird hooked its bill over the stick and brought its feet up to the perch.

It was called "Gus" and seemed to recognize its name. It would sit on the boy's shoulder as he walked up and down, and ride on the stern of the boat as he rowed about on the water. Gus was friendly with the sporting dog of the place, but showed fight if a strange dog appeared. His wing grew stronger and he would walk along the lawn waving both wings, then paddling along the ground and rising slightly. One day he took flight and flew a short distance along the shore and alighted. A search and calling failed to find him. But as the searcher was returning the bird flew past and alighted by the house. It took these flights daily and always returned to a perch on a stone wall by the water. There it would sit for hours. If it fell asleep it hung its head to the full length of its long neck down the side of the wall, as the red-footed boobies do on their nests, looking as if dead. Sometimes the boy, to show him flying, would toss him into the air over the water. Once when he did this it was too soon after feeding, the bird found it was carrying too much weight and disgorged a portion of its fish. Sometimes he resented being made to fly, and would alight in the foliage of trees fringing the shore and hide there. He never attempted to bite but opened his mouth threateningly if teased or afraid.

In meditative mood.

His flights became longer, and fearing he would leave, a Fish and Wildlife Service band No. 40-721701 was placed on his leg. A friend came one day and took some pictures of Gus. Next day he was seen to rise in flight, but instead of flying along the coast as heretofore he headed to sea towards the bird nesting island, Moku Manu, in sight about six miles away. Watched with a field glass, he was seen to alight on the water to rest, and then take off and continue his flight. It is not known whether or not Gus rejoined his companions on the island. I visited the island a few weeks after he left and as the boat approached it a young brown booby came out and flew around the boat as is their wont, but he did not come to my call or alight, so we could not be sure it was Gus. We hope he has joined his companions there and may turn up later at some distant island and be identified by his numbered band.

On Tau Island, one of the Manua section of the Samoan Group, in 1938, I saw a tame brown booby. It had been brought from Rose Atoll about 100 miles away. It was quite tame among the Samoan children. The natives said it went to sea to fish and returned regularly to the village. This is also evidence that the brown booby is tractable with human society. However, it held its dignity and protested with defiant squawking when boys attempted to tease it.

Courses at Havana

War or no war, the University of Havana is carrying on its summer session courses, running from July 10 to August 19. Of special interest to *Nature Magazine* readers are courses in the flora and fauna of Cuba, its economic geography and resources and its archaeology. Full information may be obtained from Secretario de la Escuela de Verano, Universidad de la Habana, Habana, Cuba.

Have you any WILD FLOWERS in your garden?

These wildings of the woodland add an exotic charm to the shaded corner or the spot you had not known how to treat.

BUT to grow wild flowers you must know their needs of soil and care. Many of our rarer wild flowers have become so because they have not been gathered with care. Seeds of many are now available, and you may wish to save a clump of some kind threatened by the steam shovel, the road builder, or the woodsman.

IF you do you should know your wild flowers. You will find this knowledge in text and in many pictures in

PIONEERING WITH WILD FLOWERS

an attractively written, fully illustrated book based on a lifetime of study and experience raising wild flowers.

Send Two Dollars to

BOOK DEPARTMENT

AMERICAN NATURE ASSOCIATION

1214 16th St., N. W., Washington 6, D. C.

BIRD AND ANIMAL

PAINTINGS

By R. Bruce Horsfall

ONLY $1.50

A beautifully printed book containing 168 pictures in full colors of birds, mammals, and insects, three and one-half by two and one-half inches, and a beautiful frontispiece has been printed and is now available.

Each picture is accompanied by concise description of the character and habits of the subject.

Helpful suggestions are included to show the use of the book for school, camp, home and other educational purposes.

Despite the high cost of color plates and printing all this will cost the readers of Nature Magazine only

$1.50 Postpaid

American Nature Association
1214 Sixteenth Street, Washington 6, D. C.

YOUTH IN THE GARDEN

(Continued from page 323)

persuaded to start a group Victory Garden last summer. These lads, who had been something of a neighborhood problem, were so proud of their efforts as gardeners that they not only protected their own garden from vandalism, but also assumed the role of garden M. P's. for the other gardens in the neighborhood. There is something about being the owner or manager of a piece of tilled land, no matter how small, that seems to breed a sense of responsibility both for young and old.

However, I would not suggest that children should be urged to garden just to reform them. Character building is a valuable part of this constructive activity. But the educational value of making things grow is equally important. And when the children themselves find that it is good sport, too, what more could one ask?

Note: The National Victory Garden Institute, Inc., 598 Madison Avenue, New York (22), N. Y., has a leaflet and bibliography on children's gardens which will be mailed on receipt of a stamped, self-addressed envelope.

Tree Swallow Allies

Lawrence A. Hautz is a Milwaukee business man with an enthusiasm for birds. He is a particular admirer of tree swallows as an important bird ally. One of these birds, he points out, will consume 2000 mosquitoes daily, and if you would keep the mosquito population around your home in check—and, possibly, avert malaria—he urges the erection of homes for tree swallows. Mr. Hautz did not stop with urging action, however, but printed and distributed, free, six thousand copies of a booklet entitled "Bird Houses and Feeding Shelters In Wisconsin." These went to the manual training departments of Wisconsin schools. The result has been a building boom in bird houses. Instructions include homes for all members of the swallow family—all prodigious insect eaters. More power to Mr. Hautz.

Dog Week

National Dog Week will be observed from September 17 to 23 this year with the slogan for this seventeenth consecutive observance "In War, In Peace, "Man's Best Friend'." The objective of the week is to make the dog more valuable to its owner and more acceptable to the non-owner. Achievement of the latter objective involves, in our opinion, some education of dog-owners—and we speak as one. National Dog Week headquarters, 3323 South Michigan Boulevard, Chicago 16, Illinois, offers a map featuring accurate sketches of the 166 known breeds of dogs for each dollar contributed to the Dog Week fund.

Protect Your Garden

From APHIS and Similar Insects

There is an easy and sure way to control aphis, leafhoppers, most thrips, mealy bugs, lace bugs, young sucking bugs, and similar insects.

Spray Early and Often with BLACK LEAF 40

One ounce makes 6 gallons of effective aphis spray. Economical, easy to apply—a little goes a long way. Spray early before insect damage causes trouble.

Just a little spread on roosts kills poultry lice and feather mites.

Ask Your Dealer.

TOBACCO BY-PRODUCTS & CHEMICAL CORPORATION, Incorporated, LOUISVILLE 2, KY.

GARDEN FOR VICTORY

LOOK FOR THE LEAF ON THE PACKAGE

A BIG $1.00 WORTH

The following seven Handy Dog Booklets by Capt. Will Judy (each 16 pages) are well illustrated and chock full of valuable information. Only $1.00 for the set of seven.

- Feeding the Dog
- Housebreaking the Dog
- Puppies and Their Care
- Whelping of Puppies
- Laws about Dogs
- Anatomy of the Dog
- How to Sell Dogs

BOOKS on DOGS

"Man's Best Friend"

All these books are generously illustrated, well printed, practical, helpful and complete.

The following five general books are by CAPT. WILL JUDY

TRAINING THE DOG—Includes all training for ALL BREEDS—hunting, trick and stage work, leading the blind, housebreaking, the dog in the street and in the automobile, avoiding poisoned food, noisy and fighting dogs; every possible field of training Price $2.00

DOG ENCYCLOPEDIA—The complete book of all dog subjects (includes free supplements). Answers every question on every dog subject from A to Z. 462 pages, 375 illustrations, 587 subjects. Price $5.00

PRINCIPLES OF DOG BREEDING—A practical presentation of heredity, bloodlines, pedigrees and scientific breeding. Price $3.00

KENNEL BUILDING AND PLANS—For one dog or a hundred dogs. How to build a complete kennel, alter, repair or enlarge. $3.00

CARE OF THE DOG—38 chapters on everything the owner of the pet dog or house dog should know concerning his dog. Many pictures, much sensible advice, over a thousand helpful suggestions. Price $1.50

Order direct from

NATURE MAGAZINE

1214-16th St., N.W., Washington 6, D. C.

ATTRACT IF YOU WOULD WATCH

By GORDON W. JONES

The soft dark brown helpless charm of my first baby flying squirrels was unforgettable. That was many years ago in an Indiana college. A classmate had found them in a hollow tree on the campus and brought them to class.

There were four of these tenderlings huddled together in his cap. Each showed already the lateral fold of redundant skin that forms the gliding membrane.

After we had all admired the little things, and the professor had told us

something of the zoology of the animals, he cautioned us against disturbing the young of the wild. The proud discoverer willingly volunteered to return the young to their nest at once. We learned that flying squirrels are common enough in most of our states but are seldom seen, simply because of their nocturnal habits.

This little college incident set me to fretting about the fact that I never seemed to see many of the wild things that were observed by some others my age, who had no more woods experience. The classmate who had discovered the squirrels told me he had found it simply by tapping loudly on the hollow tree. The startled parent had left the nest in a revealing dash.

The next summer found me tramping the woods about home banging my stick against all actually and possibly hollow trees. My luck held true — no flying squirrels. Finally I hit upon the plan of placing nest boxes in the trees with the hope that possibly the little animals would consider them good homes. It seemed the only way of making the mountain come to Mohammed.

Three empty nail kegs with the tops replaced were used. A 4″ by 4″ hole was cut in the upper end of one stave of each. These proved to be the lightest and simplest squirrel penthouses to lift through the branches.

One I placed in a large beech tree deep in the woods, miles from a clearing. An oak tree at the edge of the timberland seemed suitable for another. The third was nailed high in a huge cedar not far from the oak. The first two were not more than fifteen feet above the ground.

The keg in the cedar has been consistently ignored, for some reason, by all the woods creatures. But the next summer found the other two obviously occupied. The box in the beech tree was so densely packed with dead leaves that they actually seemed to overflow. The recent presence of some animal was proven by one green sprig among the brown.

Gentle taps on this box sent the tenant scampering into the dense foliage. I thought it was actually a flying squirrel but it moved too fast among the leaves.

The other keg was likewise full of old leaves. Several knocks brought no response, but, as I was about to leave in disappointment, I heard a rustling and was thrilled to see a beautiful, golden-brown, rather bushy-tailed animal the size of a rat dash up the tree trunk. A moment later it sailed quietly to the safety of a nearby hickory.

This experiment has pointed the way to a simple means of glimpsing a pretty and secretive denizen of the woods. Further, even if no flying squirrel accepts your hospitality, perhaps some other mammal or bird—even a screech owl—will do so. Certainly some artificial means of replacing the greatly lessened number of hollow trees is needed.

Snowy Owl

Under the auspices of the Bowdoin Scientific Station at Kent Island, Bay of Fundy, Dr. Alfred O. Gross has conducted a careful study of the food habits of this interesting bird. His results, published originally in *The Auk*, have been made available in reprint form in a pamphlet entitled "Food of the Snowy Owl." Examination of stomach contents, during recent invasions by the birds, revealed the facts. Summing up the results, Dr. Gross says that "the evidence is about equally for and against the Snowy Owl so far as the economic interests of man are concerned. The species is beneficial by reason of its destruction of mice and, especially, that most despised of all rodents, the Norway rat, but it is also very destructive to game and song birds, poultry and certain useful mammals. The total number of birds and useful mammals that are eaten is just about equal to the number of destructive mammals, and hence little can be claimed in favor of the Snowy Owl on the basis of its food habits. However, most of us will agree that this owl does deserve a place on the protected list because of its esthetic value. Who is there that does not receive a thrill of delight on seeing one of these white visitors from the north?"

The Ruffed Grouse

This is the title chosen by the Audubon Society of Western Pennsylvania for its official publication, which makes its bow with the year 1944. Under the editorship of E. H. McClelland, the first issue contains an article on western Pennsylvania, from the viewpoint of its effect on the fauna of the region, by Edmund W. Arthur; a discussion of ecological plant geography of western Pennsylvania as related to bird life by Dr. O. E. Jennings; a paper on the changes in bird life in the area by W. E. Clyde Todd; an article on the bird regions of western Pennsylvania by George B. Thorp; a discussion of bird watching as a hobby by Fred S. Bennett. Bird records of Pennsylvania are discussed by Comly B. Shoemaker, while Hal H. Harrison gives some hints on photographing wild birds. "The Todd Wildlife Sanctuary" is the title of an article by C. H. Manley, Dorothy Auerswald writes of bird sanctuaries generally, and Mary Lou Brown reports on an interview with John M. Phillips on planting for birds and other wildlife. *The Ruffed Grouse* has set a high standard with its first issue and we wish it a long and successful career.

Mullet for Farm Ponds

Mullet is a salt water fish but specialists at the Fish and Wildlife Service's laboratory at Beaufort, N. C., are trying to change its habits. There is need for new and better sources of fish to stock thousands of farm fish ponds, so the mullet, a dweller in warm waters throughout the world, is being used as a piscine guinea pig. It is found to be able to live in brackish waters, and the next step is to accustom it to fresh water. A hardy and numerous fish, it can be transported with less danger of injury than many other species. If the current experiments are successful, a prolific source of fish can be tapped for "planting" in farm fish ponds, most of them in the South.

TEAMWORK IN NATURE

(Continued from page 304)

calf was left unfettered in a compound with the cow, which was securely shackled to the posts of a large shed. During the night the compound was aroused by a commotion, and upon investigation it was found that the calf had broken down the fence and escaped.

Two nights later the household was again aroused, and arrived at the scene of the disturbance just in time to see the cow trotting away toward the nearby forest, flanked by two large bulls and followed by the calf—or at least, a calf of the same size and appearance as that which had escaped two nights previously.

Examination of the posts to which the cow had been tethered showed that the stout chains had been twisted and snapped. The size of these chains and the fact that they had been attached to the cow elephant's hind legs clearly showed that the captive had not freed herself. Evidently the bulls had, by knotting the bonds with their trunks and cunningly bringing leverage into play, sundered them and freed the cow. Two wild animals had entered the very home ground of the hunters they had the most cause to fear, and had released one of their herd. And they had probably been led to the captive elephant by the calf!

Along the shores and in the estuaries of eastern South America are found remarkable animals known as four-eyed fishes. We lived for a while on the coast of the Guianas where the sea is shallow and muddy, and we had plenty of time to watch these creatures. As the tide went out, pools would often be left between the mud banks, and groups of four-eyed fish were occasionally caught in them. Since the pools dried out rapidly after the fall of the tide, the fish were in imminent danger.

First one and then another would rush at the mudflat that separated the pool from the retreating sea, and leap out upon the mud. Those that did not reach the sea would flap about furiously and clumsily until they worked their way back to the pool, but sooner or later one would reach a channel or another pool that led to the ocean. Then a curious thing happened.

Instead of immediately racing forward to safety, the fish that had escaped would swim out a little way, turn around, make a mad rush at the mudbank, and skip back into the pool from which he had come. After hurriedly swimming among his imprisoned brothers for a few seconds, this leader would charge the mudbank once more, followed by the others, and all would flap their way forward over the mud into the sea to safety. Thus, even a fish, apparently in opposition to its most rooted instincts, will face danger in order to aid others of its kind—an action that approaches heroism.

There is a great deal of teamwork among animals that denotes patience and sustained coördination. An example of it is found among the African weaver birds. These small birds' long, pendant nests hang from the branches of tall trees in jungle clearings—trees that are bare because the birds strip them of their leaves.

To construct these nests weaver birds work in pairs, fetching long strands of vegetable fibers, which they droop over a branch, and form a large pendant nest shaped much like a woman's stocking. For days the pair work together, one on the inside and one on the outside, passing the ends of the fibers through to each other with their beaks. The end of the stocking is then expanded into a bulb with a small circular opening at the bottom and in it a small platform is constructed to hold the nest. The result is an amazing example of craftsmanship and of skilled coöperation.

Sometimes a party of animals teams up to accomplish something that will benefit their entire community. Cherry Kearton, the English naturalist, who spent a year on an island in the southern Indian Ocean that is a breeding place of penguins, records an astonishing incident of this kind about these quaint birds.

Every morning the penguins paraded down to the sea for a swim, always following paths that they had made. These paths often crossed areas of level, bare earth, which became slippery fields of slime when it rained. and the penguins found it impossible to walk upright on such a surface. So gangs of the birds pecked at the ground, scoring it with their beaks into a series of sharp ridges like a gridiron. They kept at this hard labor for hours, until the path was transformed into an evenly ridged thoroughfare along which all the penguins of the community could pass without danger of slipping.

Thousands of them used these paths every day, and as soon as the ridges became broken down, gangs would get busy at repair work—voluntary work of service to the whole community, and truly teamwork of a most advanced kind.

Living Memorials

Writing in *The Conservation Volunteer*, the excellent official bulletin of the Minnesota Department of Conservation, Richard J. Dorer urges the planting and dedication of forests in memory of those who have fallen in the Nation's service. He points out that these would be living memorials in contrast to monuments and buildings, and would be contributions to the natural resources of the country for which these men fought and died. Such forests would provide for wildlife and serve many other conservation purposes. Many trees and small forests were so planted and dedicated after World War I, but Mr. Dorer would like to see this idea expanded to include larger areas.

Know Your Stars

Broaden your scope of understanding beyond our little world; reach out for information about the universe; it's interesting and not so very complicated.

The earth rushes through the solar system at an amazing speed. Every night we have new neighbors, some familiar friends; others, with a distant mysterious look, challenging identity.

Own a star finder and you are behind the scene of this year's heavenly displays. Have at your finger tips a mirror of the sky for every hour of darkness.

Handy Star Finder

(Size 8½ x 8½ inches)

An excellent and accurate device for amateur astronomers. Equipped with a sliding screen adjustable to any northern latitude. It gives the right ascension of the principal planets for the years 1941 to 1945; names of constellations with their principal stars; astronomical terms; distances of the planets from the sun.

A Real Value at Only 50c Each

(Quantity discounts to schools for classroom use)

NATURE MAGAZINE
1214 Sixteenth St., N.W.
Washington 6, D. C.

Enclosed is ..... for which mail me postpaid ..... HANDY STAR FINDERS.

Name .....

Street Address .....

City and State.....

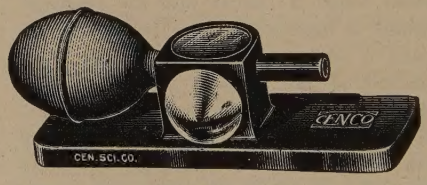
Under the Microscope

By JULIAN D. CORRINGTON

DIFFUSION AND OSMOSIS

Certain phenomena in the realm of physics lend themselves to microscopic examinations that are simple and interesting. At the same time, some of these are of paramount importance to a full understanding of plant and animal physiology and make excellent demonstrations for the individual or for classroom instruction.

Most sciences are based upon fundamental concepts still termed "theories" since they were theoretical when first proposed and old names cling tenaciously. To retain this title in well-established cases at the present time is, however, misleading and tends to discredit the subject in the minds of laymen. The word theory connotes something unproven, therefore the germ "theory" of disease is a scientific guess not fully validated! Many biologists commit the error of still loosely and carelessly using the phrase "cell theory"—even in textbooks—when, as a matter of fact, the truth of the statement that all plants and animals are composed of cells and their products is worked out by thousands of students each year in elementary biology laboratory exercises. The whole of modern genetics, with its countless array of predictable results of plant and animal breeding experiments, rests upon the "theory" of the gene, while physics and chemistry have the atomic and molecular "theories" as cornerstones. Finally, all factual knowledge is meaningless without the "theory" of evolution. We should by all means discard this term and speak of the principle, law, or doctrine in such cases.



Brownian Movement Apparatus

Cells are readily discerned under low magnification; not so the ultramicroscopic gene, atom, and molecule. Yet these entities make themselves known by their activities. We cannot see the filterable virus that gives us a cold, but we are, alas, all too well aware that the disease is no theoretical matter. The present article will deal with some of the methods by which the activity of molecules can be rendered visible.

One of the fundamental laws dealing with the physical properties of matter states that at any temperature above absolute zero it is always in motion. The physicist tells us that matter is made up of very minute particles termed molecules and that these are spaced instead of being continuous. In solids, as a bar of iron, the molecules are so close together, and attract one another so strongly, that they have only a limited freedom of movement and the object is rigid; in a liquid the molecules are farther apart but exert sufficient attraction so that, while the fluid matter can flow, it remains coherent and maintains a constant volume; in a gas the molecules are so far apart that they tend to fly off in every direction, the attraction force being insufficient to overcome the high speed of these particles. This speed, considering the ultramicroscopic size of the moving objects, is enormous; for example, the average velocity of air molecules is 1200 feet per second.

The molecules of a gas such as air cannot be seen, but if we place some extremely small yet still visible particles of solid matter in such a gas we can, under the microscope, observe a bombardment of the particles by the whizzing molecules. This phenomenon was discovered in 1827 by the British botanist, Robert Brown, and bears the name of Brownian movement, also sometimes termed pedesis. It may be demonstrated in either a gas or a liquid and we shall describe both procedures.

A Brownian movement apparatus, designed by the Ryerson Laboratory of the University of Chicago, and manufactured and sold by the Central Scientific Company, is a small and efficient instrument for viewing this fascinating activity in a gas. A metal box is provided with a glass top plate, which is placed under a microscope objective, and also a side opening that houses a strongly convex lens to focus a beam of intense light horizontally upon the air contained within the chamber. A rubber bulb delivers a tiny jet of cigarette smoke within the box and it is the very minute carbon particles of the smoke that one sees, brilliantly illuminated in a black field. As with the darkfield microscope, the only light that passes to the observer's eye is that which the partices reflect, and they would be objects of beauty even if motionless. But behold how the brightly shining minuscles twist and turn and dance, darting now this way and again off at another angle! It is indeed a noteworthy and impressive spectacle, and its explanation is that the visible particles are so small that they are struck only now and again by the high speed air molecules, first on one side and next on another. Larger objects would be hit simultaneously on all sides by a great many molecules and show no such effect. Under magnifications of 50 to 100X, this apparatus provides compelling evidence of the discontinuous nature of a gas.

In a liquid, Brownian movement may be seen under the high power of an ordinary laboratory microscope by placing a tiny pinch of carmine in a drop of water and adding a cover glass. Any very finely-ground insoluble solid will serve, as lampblack or gamboge. Focus only on the smallest visible particles, with moderately dim light, and they will be seen to be in the irregular, spasmodic motion induced by the bombardment of water molecules. The demonstration is much more spectacular under darkfield illumination.

These projects show how diffusion takes place. If some copper sulphate solution is poured slowly through a glass tube that leads to the bottom of a tall cylinder of water, the heavier blue liquid can be made to lie beneath the water, with a sharp line of separation. After a while the cleavage is no longer definite and, in a day or so, the water is uniformly tinted everywhere with the diluted blue; the two fluids have mixed uniformly, the particles of one have diffused among the particles of the other. This occurs because the molecules of each substance are in constant motion and are free to move throughout the combined limits of the two fluids until evenly spaced.

When a puff of cigarette smoke is blown into a room, we can see the smoke cloud for a short time and then it gradually becomes less and less distinct and disappears. The carbon particles have been hit by air molecules and dispersed evenly through all parts of the room. A pungent chemical, uncorked in one corner of a room, can before long be detected in all corners. Heat speeds up molecular activity; when water is heated, the molecules bestir themselves more and more violently as the temperature rises until at last they gain such terrific momentum as to escape from the fluid body altogether, shooting up into the air as water vapor, an invisible gas. For all substances there is a temperature at which they can exist in any one of three states—solid, liquid, and gas.

Osmosis is a special case of diffusion, where two solutions of different concentrations are separated by a porous membrane or surface, and a device to demonstrate this performance is commonly called an osmometer, although the term should be restricted to an instrument designed to measure the force generated.

A favorite form of osmometer is made by removing the shell from an area the size of a quarter-dollar at the large end of a

a fresh egg, taking care not to injure the delicate shell membranes immediately beneath. The two membranes, so closely applied as to appear as one, are to serve as our osmotic partition, generally referred to as a semi-permeable membrane. The contents of the egg are removed from a small hole drilled in the opposite end of the shell, after which the egg is filled with a strong solution of cane sugar in water that has been tinted pink with eosin, and a long piece of glass tubing is then fitted into this hole and the joint made water-tight with sealing wax or other insoluble adhesive. Thus prepared, the egg is suspended in a battery jar of water, the glass tube extending up vertically and held by clamps to a support. A meter stick may be rigged alongside to measure the progress of the experiment. The eosin is merely to tint the water that will rise in the tube, and may be omitted.

Molecules of the water in the battery jar, bombarding the shell membranes, are small enough to pass freely through the ultramicroscopic pores. Likewise the water molecules inside the egg are doing the same with equal success in the opposite direction. But the sugar molecules are too large to get through. As a consequence, all molecules outside can pass into the egg, but only some of those inside can escape to the exterior. The resultant is a flow of water through the animal membrane into the egg, forcing its contents up the vertical tube. There is more water per unit volume outside the egg than inside, and the direction of osmosis is always from the purer water to the more diluted water; from the greater concentration of water to the lesser.

Unfortunately, before the full explanation of this vastly important process was forthcoming, the statement became current that the direction of osmosis was always from the solution of lesser concentration to that of the greater, referring to the concentration of the sugar. If the outer jar contains a ten percent sugar solution and the egg a twenty percent solution, the flow will be into the egg, as before, but with less force than if the large vessel contained pure water.

We have rigged up tubing, in demonstrating this performance to students, that reached all the way up to the ceiling, and in twenty-four hours or a little longer, have seen the sugar solution forced all the way up to the top, and spilling over. The force exerted is terrific; if the osmometer contains a twenty percent sugar solution and the outer vessel plain water, the pressure attains that of twenty-five atmospheres. Attempts to measure this force by seeing how much pressure must be applied to a piston to stop it will shatter all membranes or ordinary osmotic partitions long before the limit is reached. Especially strong containers with porous walls must be used.

Any device employing a semi-permeable membrane or unglazed porcelain vessel can be used in this demonstration. A carrot or turnip, hollowed out until only a thin shell, filled with sugar solution, and attached to a tube with sealing wax; an inverted thistle tube, covered with a piece of membrane, as from a pig or turkey bladder or sausage lining; a diffusion shell of parchment for small quantiies of fluid, and still others. When a chemist separates crystalloids from colloids in a solution by means of their unequal diffusion through a membrane, the process is termed dialysis.

Diffusion, osmosis, and dialysis go on within the bodies of plants and animals throughout life. By these means we take in our food, water, and oxygen, and get rid of excretions, the semi-permeable membranes being the lining epithelia of lungs, intestine, kidney tubules, blood vessels, and cell walls generally. So it is that plant roots take in water and salt solutions from the soil; in fact, the business of living involves a continual transference of materials in and out of cells through microscopic membranes, and is only possible because molecules are always traveling about in a state of violent agitation—colliding, repulsing, attracting, rebounding, according to path, velocity, gravitational attraction and electric charge — responding to external forces, uniting, separating, but forever on the march.

TRADE NOTES

A thoroughly practical aid to students in any course of study, is *Doctor in the Making*, by Arthur W. Ham, M.B., Associate Professor of Anatomy, and M. D. Salter, Ph.D., Lecturer in Psychology, both of the Faculty of Medicine, University of Toronto. The teaming of these two authors proves to be a very fortunate combination of medical and psychological approaches and provides, at last, a badly needed small book on what to do and what not to do in preparing for and studying medicine. No vague generalizations here, but precise statements on who should and who should not enter this field, on the overcoming of difficulties, organizing knowledge, budgeting time, training the memory and the understanding, and on recognizing and correcting faulty study habits and emotional states. Ability plus proper preparation should guarantee success as a medical student, but they do not, and the authors have explained how they have found that habits of study and personality characteristics and attitudes were of great importance in work on this problem at their own school. By substituting some other given subject for medicine, this book will prove equally useful for those in other specialties, and one wonders why such an obviously helpful book was not written sooner. You will like the intimate, easy style, and the

References for the Microscopist

(Third List)

In previous issues we have offered a number of important texts and reference works on the microscope, microtechnique, and various background sciences. This third listing includes five additional subjects, all of them important to the microscopist who wishes to build on firm foundations. We suggest you add some of these titles to your library; mention them to friends and family as suitable remembrances; note them as gifts for that fellow microscopist.

CRIMINOLOGY

Finger Prints, Palms and Soles, by Cummins and Midlo. New and complete general work; all aspects of subjects, criminological, biological, historical ----------$4.00

EMBRYOLOGY

Fundamentals of Comparative Embryology of the Vertebrates, by Alfred F. Huettner. Best and most recent general comparative text, beautifully illustrated ----------$4.50

Developmental Anatomy, by Leslie B. Arey. Famous standard text on human embryology; a mine of detailed information ----------$6.75

HISTOLOGY

A Text-Book of Histology, by J. Lewis Bremer. Fifth edition of one of the most widely used standard texts ----------$6.50

Handbook of Microscopic Characteristics of Tissues and Organs, by Karl A. Stiles. Practical laboratory companion for identifications ..$1.50

MYCOLOGY

Textbook of Mycology, by E. A. Bessey. Complete work on classification, structure, life histories of the fungi ----------$4.00

The Advance of the Fungi, by E. C. Large. Important and fascinating account of warfare between fungi and man; how fungi have shaped human civilization; for readers of all classes ----------$4.00

PARASITOLOGY

Parasitology, by Hegner, Root, Augustine, and Huff. Comprehensive coverage, authoritative, highly interesting ----------$7.00

Clinical Parasitology, by Craig and Faust. Medical reference work on parasites of man; recent, exhaustive, standard ----------$9.00

ORDER FROM

MICROBOOK DEPARTMENT
NATURE MAGAZINE
1214 Sixteenth St., N.W.
Washington 6, D. C.

numerous cartoon drawings that make this volume a guide book to a successful career. Pp. xi, 179; 12 illustrations. J. B. Lippincott Co., 333 West Lake St., Chicago 6, 1943. $2.00.

At a time when world events make the study of parasitology far more important than ever before, the third edition of Craig and Faust, *Clinical Parasitology*, has been issued, revised and amplified. Those familiar with the field know this as an essential work, a bible of the subject; to others we can say that the treatment is a model of thoroughness, organization, and practical information, beautifully and fully illustrated. The new edition includes an enlarged type page that has the effect of adding 100 pages of text; forty new figures, four full-color plates, and two clinical tables have been added.

In plan, this volume goes systematically through each phylum, class, order, family, genus, and species of human parasite, and presents for each its history, distribution, morphology, biology and life cycle, epidemiology, pathology, diagnosis, prognosis, treatment, and prevention. It is intended for all persons interested in the subject, from bioligical students to physicians, technicians, and directors of diagnostic or public health laboratories. An appendix explains the various techniques of collection, preparation, and identification, and there is a very extensive bibliography and both an author and subject index. Pp. 767; plts. 4, figs. 284. Lea & Febiger, Washington Square, Philadelphia 6, 1943. $9.00.

In past issues we have reviewed books in the Pictured Key Nature Series, written and published by Professor H. E. Jaques at Mt. Pleasant, Iowa. One of the newest of these splendid and useful manuals is *Plant Families, How to Know Them*, which takes up all groups systematically, from algae through angiosperms. Uniform in size and plan with the others of this Series, this item is priced at $1.00 in spiral wire binding, $1.80 in cloth, with discounts for quantity purchases.

An introduction on plant facts is followed by instructions for use of the key. Next comes a key to the four great divisions of the plant kingdom, then the illustrated key to each division in turn, down to family, with well known specific examples. The keys include not only the usual statement of characteristics, but also well executed outline drawings of the entire plant, or of all the parts on which identifications are based. The wording employs a minimum of technical terms, yet remains scientifically correct; the book can be used by anyone, in the field or laboratory. It ends with a phylogenetic list of plant families, and a combined, illustrated, glossary and index. Pp. 174, figs. 528. Order direct from the author.

A PICTURE WITH A DEVIOUS HISTORY

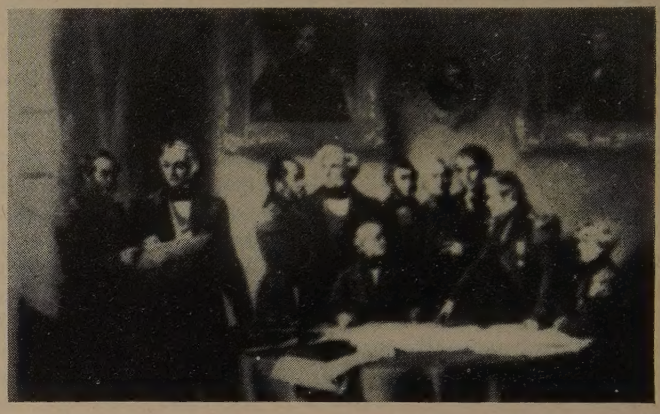
Some while ago in these columns we discoursed upon the micro-writing on glass of William Webb, a curious hobby that has become practically a lost art. This script is unbelievably minute, requiring considerable magnification to render it readable, and ties in with the subject of microphotographs.

For those of our readers who may not know the distinction, a photo-micrograph is a photograph of a small, usually microscopic, object, made through a microscope so as to present a picture of what one sees when looking through the microscope; a microphotograph, on the other hand, is a minute photograph of some larger object, made so small that a microscope is required to see it in any detail. Thus, a painting, a bank note, the Lord's prayer, or any desired subject may be minified by photographing it upon a prepared microscope slide through the wrong end of a microscope, reducing a picture that is originally, say 10 x 12 inches, down to a mere speck, measured in fractions of a millimeter. When such a slide is viewed under a microscope, the painting appears much enlarged, apparently in more or less of its original dimensions. The making of such slides has long formed a hobby for a limited number of microscopists, but cabinets of these, once fairly common, are collector's items today.

Our article prompted a letter from Professor Joseph G. Fallon, Department of Biological Science, Pacific Union College, Angwin, California. Dr. Fallon inherited an Oberholzer microscope and collection of slides of numerous objects, including some made by Webb and a number of microphotographs, from his great, great grandfather, a textile chemist by profession and microscopist by avocation. The grandfather, late superintendent of the Pequot bleachery in Salem, Massachusetts, also had microscopy as his hobby, being especially interested in textile fibers. With this fine old microscope in the family, Dr. Fallon was early interested in microscopy.

The older mounted slides, writes Dr. Fallon, used very thin sheets of mica for our present-day cover glasses. One of these sheets was pasted to a slip of paper, over a cut-out area, like a window over the material to be examined, then the entire paper glued to the glass slide, with no mounting medium such as balsam over the object under the mica sheet. Among fourteen subjects sent us we have selected one as an example of a most curious history that we believe will interest our readers.

The original of the picture herewith reproduced was an en-



Engraving of the Arctic Council

graving by James Scott of the Arctic Council discussing the plan for search for Sir John Franklin, famous British naval officer and arctic explorer (1786-1847) who was lost in attempting to discover the Northwest Passage. This engraving, or more likely a copy or photograph of it, was then microphotographed upon a regulation glass microscope slide that had been coated with an emulsion, developed, fixed, and covered with a mica film, forming a part of the collection now Dr. Fallon's.

The present owner then proceeded to make a photomicrograph of the microphotograph, a feat which presents difficulties on account of the grain size of the emulsion to be used. He employed Eastman Microfile film, developed with Edwal 12, and made a print on P.M.C. No. 1 contrast bromide Eastman paper, using D 72 as the developer for the print. This procedure eliminated most of the grain. A new Bausch & Lomb student microscope was used with a Zeiss six-volt, high intensity, Wohler principle lamp, having an aspherical lens. The camera was a Leica with a 3.5 lens and the exposure was one-sixtieth of a second. This print, as received by us, is a trifle hazy in spots but shows all of the features of the Council members with recognizable distinctness.

Now the print, measuring 3½ x 6 inches, was made into a half-tone for reproduction in the usual fashion, causing further loss of detail, though also gaining somewhat by reduction in size. And so here you have a picture which was first minified, then magnified, then reproduced for publication, a procedure guaranteed to exercise the good members of the Council in their respective sepultures did they but know the unwarranted liberty taken with their several portraits.

PUZZLE PICTURE

That curious looking photomicrograph in our April issue was leather. Industrial microscopists would recognize it at once, but most of us have never seen an enlarged view of this familiar subject and would be fooled into making wild guesses.